00046017

V
331.0954
Wat/sel
46017

00046017

Digitized with financial assistance from the
Government of Maharashtra
on 18 July, 2018

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

Calcutta, the 14th February 1889.

MEMO.

It has been arranged to publish, from time to time, in the form of these "Selections," papers and extracts from the Records of the Government of India, Revenue and Agricultural Department, relating to Indian products, which contain information likely to be useful to officers of Government or the public, or deal with commodities regarding which further particulars are desirable. The Reporter on Economic Products will be glad to receive and acknowledge any communications bringing to notice additional facts bearing on the subjects dealt with.

The Selections will be numbered and paged consecutively to admit of being bound up in Annual Volumes.

CONTENTS.

CONTENTS OF VOL. I.

PART I.

No.		PAGES
1.	Musa textilis or Manilla Hemp, by Dr. George Watt	1—6
2.	Indian Grains suitable for Canada, by Dr. George Watt	7—14
3.	Wool Production, Consumption, and Trade in India, by Mr. F. M. W. Schofield	15—52
4.	A Note on a Red and Yellow Dye formerly used in Bombay, by Dr. George Watt	53—58
5.	A Tea Substitute used in the Himálayas, by Dr. George Watt	59—60
6.	Cobaltiferous Matt or Cheep from Nepal, by Dr. W. King, Director, Geological Survey	61—62
7.	Supposed discovery of Petroleum in Alwar, by Dr. W. King	63—66
8.	Adhatoda Vasica as a green manure, by Dr. George Watt and numerous correspondents	67—82
9.	Indian Tanning Materials, by Dr. George Watt, and a Note on Tanning and Currying as practised in India, by Captain J. Stewart	83—112
10.	Coix Grain or Job's Tears, by Dr. George Watt, assisted by numerous contributors	113—146
11.	History of Yams and the various species met with in India, wild or cultivated, by Dr. George Watt	147—166

PART II.

12.	A Note on the Indian Fibres required by Her Majesty's Secretary of State for India, by Dr. George Watt	167—180
13.	Some of the More Important Fibres of India, *e.g.*, Bauhinia Vahlii, Calotropis gigantea, and Caryota urens, by Dr. George Watt	181—190
14.	A Note on the Cocoa-nut Fibres, by Dr. George Watt	191—214
15.	A Note on Jute (Corchorus), by Dr. George Watt	215—244
16.	A Note on Sunn-hemp (Crotalaria), by Dr. George Watt	245—264
17.	Malvaceous Fibres (Hibiscus, Malachra, and Sida), by Dr. George Watt	265—282
18.	Rhea and the Allied Rhea Fibres (Bœhmeria nivea and tenacissima, Villebrunea Marsdenia, Debregeasia, and Girardinia), by Dr. George Watt	283—322
19.	The Flosses and Silk Cottons of India (Bombax, Calotropis, Cochlospermum, Eriodendron, Kapok, &c.), by Dr. George Watt	323—339

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

Calcutta, the 14th February 1889.

MEMO.

It has been arranged to publish, from time to time, in the form of these "Selections," papers and extracts from the Records of the Government of India, Revenue and Agricultural Department, relating to Indian products, which contain information likely to be useful to officers of Government or the public, or deal with commodities regarding which further particulars are desirable. The Reporter on Economic Products will be glad to receive and acknowledge any communications bringing to notice additional facts bearing on the subjects dealt with.

The Selections will be numbered and paged consecutively to admit of being bound up in Annual Volumes.

VOL. I.; PART I. (No. I.); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

MUSA TEXTILIS.

Dated Calcutta, the 28th July 1887.

From—R. BLECHYNDEN, Jr., Esq., Deputy Secy.,
Agri.-Horticultural Society of India,

To—The Under-Secretary to the Government of India,
REVENUE AND AGRICULTURAL DEPARTMENT.

I have the honour, by direction of the Council of this Society, to acknowledge the receipt of your No. 144—8-20 F. & S., dated the 9th June, forwarding two samples of **Musa textilis** fibre for examination and report, and enclosing copy of letter from Colonel Cadell, V.C., Superintendent, Port Blair and Nicobars, and extract of a letter from the officer in charge, Northern District, to the Superintendent, Port Blair and Nicobars.

The two samples of **Musa textilis** fibre have been carefully examined and tried. The results obtained at the first trial were contrary to those expected, consequently further trials were made; they, however, confirmed the results first obtained, but this caused some delay in the preparation of the report and in replying to your communication.

As stated by the officer in charge, Northern District (Andamans), in his letter above referred to, the two samples of fibre were prepared by different processes—the larger sample weighing 13lb having been prepared simply by scraping with a blunt knife, while the other sample, weighing 32lb, was steeped in running water and then beaten out.

The two samples closely resemble each other in appearance and are both of good merchantable quality; they are of fair colour and strength and compare favourably with the "*medium*" quality fibre from the Philippine Islands; they are not, however, equal to "*best.*" Hemp of the same quality could be sold at Calcutta now for, say R20 per cwt., or say from £30 to £32 per ton in the London market; the price, however, is very fluctuating.

In the comparative trials of the two samples, the fibre prepared by the retting process proved itself the stronger, breaking with a weight of 266lb, whereas the fibre prepared by the scraping process broke at 224lb; this was contrary to the expectations which had been formed, as it was thought that the process of retting would have weakened the fibre.

In reference to the methods used for cleaning the fibre. By the information furnished it does not appear from what weight of raw material the samples were prepared, or whether there was a greater waste by one process than by the other. The retting process is unusual as respects the **Musa textilis**; and though in this instance the results have been favourable, it would be as well, before adopting it on a future occasion, to have careful trials made of the waste, cost of transporting the raw material to the water, handling, &c. Such experiments would also prove valuable records; were the results favourable it would probably prove a method which Indian labourers would more readily adopt from their acquaintance with it when dealing with jute; were such experiments determined on, it would be as well also to try the effect of retting in still water, to ascertain if it would injure the fibre.

The other method adopted, *viz.*, scraping with a blunt knife, is substantially the system in use in the Philippines. The Society is indebted to **Mr. Wilkinson**, British Consul at Manilla, for an account of the process actually in use there published in the Society's Proceedings for July 1883:—

"The following is a description of the apparatus in use in the province of Albay, Island of Luzon, for extracting the fibres from the stalks of the wild plantain (**Musa textilis**), locally known as Abacá or Manilla hemp:—

"Two strong uprights are firmly fixed in the ground and connected by a cross bar, in the centre of which a large broad-bladed knife is fixed edge downwards on a block of wood fastened lengthwise on the bar; the knife has a strong handle, which is connected by a cord to a long bamboo made to act as a spring, by being tied in the middle and the butt parallel and above the bar; the free end thus forms a supple and powerful spring and holds the edge of the knife firmly against the block; below the bar, there is a treadle attached by a cord to the handle of the knife; the mode of operation is for the worker to stand opposite the knife, placing either foot on the treadle, which he depresses, thus forcing the knife handle down and the blade up; he then places a strip of stalk (called locally *Sifa*) between the blade and the block, leaving only enough to wrap round a stock on the near side; he then releases the treadle, and the knife by the action of the bamboo spring, nips the strip firmly against the block, and on the workmen drawing the strip through, the pulp is left behind. The apparatus is extremely simple and inexpensive."

In the Bulletin for April 1887 (No. 4) published by the authorities of Kew, there is a great deal of interesting information regarding the Manilla hemp. It is there stated that the whole supply comes from the Philippine Islands; the imports to Great Britain "amounts to about 170,000 bales, and to the United States about 160,000 bales, equal to about 50,000 tons per annum." The imports to Calcutta are comparatively insignificant, being probably less than 300 tons per annum. It is stated in the Kew report that a labourer working under pressure "can clean nearly 20lb of hemp per diem; but as a rule the quantity cleaned by one man working steadily day by day averages about 12lb; usually two men work together, one cutting down the stems and splitting them, while the other cleans the fibre. At the current rate of wages in 1879 one labourer's earnings were 7½*d.* to 8*d.* per diem."

The foregoing extract is given, as it may be a guide in future experiments. The amount of fibre cleaned per man in the experiment at the Andamans having been about 7oz. and 5oz. per head in the scraping and retting process respectively. With more experience, and an appliance such as has been described, a model of which I am instructed to say can be furnished to the Chief Commissioner if required, there is no reason why the results may not more closely approximate to that obtained in the Phi-

lippines. I am to add the following extract from the Kew Bulletin already quoted from :—

"After a systematic series of trials made by the Glenrock Company at Madras in 1885, it is stated that plants put out in 1864 grew well and yielded numerous shoots; 179 stems, weighing about 60 pounds each, were cut down for experimental purposes and passed through Death and Ellwood Machines. These produced 159 lb of clean fibre, or 1·49 per cent. of green stem. The cost of cleaning the fibre was at the rate of £6 per ton, while the fibre itself, described as 'poor, weak, and flaggy, with some clean fibre of good colour,' was valued in London at £10 per ton; the best alone was valued at £25 per ton. The minute upon this of the Government of Madras is that 'unless much improvement both in the method and cost of production of this fibre can be made, the cultivation cannot be made remunerative.'"

"The fibre prepared at the Andamans being, as above stated, nearly equal to medium hemp imported from the Philippines, and being valued at R20 per cwt., and the data above given showing it is possible to produce the fibre at less than 6 pie per lb by hand labour, it would appear that there is every prospect of the cultivation of **Musa textilis** being made a productive one in the Andamans."

Note on Manilla Hemp by the Reporter on Economic Products.

Musa textilis, *Louis.*; Scitamineæ.

Manilla Hemp.

References.—*Royle, Fibrous Pl. Ind., 64; Note by Dr. Balfour, 1880; by Mr. Liotard, 1881; Tropical Agriculturist; Spons, Encycl., 983; Christy's New Commercial Plants, Part I., 50; Balfour's Cycl., Vol. II., 36 and 1016; Smith's, Dict. Econ. Pl.; Report, Royal Botanical Gardens, Calcutta, 1884-85; Report, Botanical Gardens, Saharanpur, 1885; Proceedings, Madras Government, September 1885, No. 1024, Revenue; Bombay letters No. 1747 of 1881 and No. 2548 of 1881; Reports, Saidapet Farm, 1881-82 and 1882-83.*

HISTORY OF THE INTRODUCTION OF MANILLA HEMP INTO INDIA.

It may be briefly explained that **Surgeon-General Balfour**, in a note dated 15th October 1880, urged the claims of **Musa textilis** as a future Indian Fibre. His note on this subject was communicated to the Government of India, by Her Majesty's Secretary of State, and ultimately issued to all Local Governments, Botanic Gardens, Chambers of Commerce, &c., for information or for whatever action might seem necessary. **Mr. Liotard** greatly enlarged the information furnished by **Dr. Balfour**, by giving a history of the attempts, hitherto made, to cultivate the plant in India, from its introduction in the Madras Presidency in 1858, down to the date of his note, January 22nd, 1881. As a result of the renewed interest thus awakened, various reports have appeared of the efforts put forth by the local authorities to realise the high expectations entertained both by **Dr. Balfour** and **Mr. Liotard**. The most satisfactory appears to have been that obtained in the Andaman Islands. The instructive memorandum recently furnished by **Mr. R. Blechynden** of the Agri.-Horticultural Society of India summarises the Andaman experiments, and furnishes a report on the value of the fibre produced. It will be seen that while the fibre is stated to have been good, the price at which it could be produced was practically fatal. It is possible this defect, with improved means of separating the fibre, may be overcome, and in the view of possible con-

tinued efforts, it may not be out of place to furnish a brief account of the known properties of the fibre:—

Habitat.—A native of the Philippine Islands—a fact of very considerable importance in any question of its acclimatisation in India with the view to meeting the demand for the fibre. The whole of the species of the genus are in fact South Asiatic plants, with a distinct tendency to the insular type. This is seen in the tendency of the Indian cultivated fruiting species to luxuriate in hot moist regions, within certain limitations of the sea influence. The Andaman Islands and the West Coast of India might accordingly be indicated as the regions where effort should be mainly directed towards the acclimatisation, for commercial purposes, of the Manilla-hemp plant.

Character and Uses of the Fibre.—It is one of great strength and extreme lightness, hence eminently suited for rope-making. Only about 50,000 tons of it are, however, annually required, so that the world's demand for this substance is not great, and it would seem that there is little prospect of this quantity being much increased. The waste materials and worn-out ropes afford, however, the much-prized strong manilla-paper, and a new industry has recently been started in dyeing the fibre with logwood and copper so as to allow of its being used as a substitute for horse-hair. The quality varies according to the part of the plant from which it has been extracted—an unfavourable property, since, unless great care be exercised, mixed consignments are sent into the market which fetch much lower prices than need otherwise have been obtained. The collective name for the fibre in the Philippine Islands is *abacá*; *bandala* is the harder and stronger outer fibre, the inner layer being known as *aúpos*, while the delicate fibres obtained from the edge of the petiole are known as *lúpis*. This last-mentioned form was formerly to a small extent imported into Paris, being used in the preparation of a special kind of under-clothing. This form of the fibre is, however, locally manufactured into fine cloth and shawls, and the textile either from this form or from the *aúpos* is to some extent exported to Europe. The mean length of the ultimate fibriles is 0·236 inches and the breadth 0·00096 inches. The central cavity is well developed; the walls are of a uniform thickness and the extremities taper gradually and uniformly. These are qualities which eminently fit the fibre for the rope-making industry but are ill adapted for textile purposes, although it must here be added that the *abacá* affords the textile fabrics worn by the entire population of the Philippine Islands.

Experimental cultivation in India.—The above abstract of the published facts regarding Manilla-fibre may be of some value in suggesting the course which should be followed in further efforts to acclimatise the plant and produce the fibre. The efforts which have been made to introduce the plant into Bengal have failed, the low temperature, as Dr. King reports, of the cold weather having proved too much for the plant. Mr. Duthie, in his reports of the experimental cultivation in Saharanpur, simply mentions the plant as growing in the gardens. In Madras and in Bombay the attempts to introduce the plant have proved more hopeful, especially in the districts possessing the necessary conditions briefly indicated. The Commissioner reports, for example, of the Dharwar District, that "the result of planting **Musa textilis** is therefore a great success, and I am of opinion, with regard to the experiments, it might, with good treatment and without much difficulty and expense, succeed well." The Director of Agriculture, Madras, remarks that "There is sufficient evidence that the plant will grow in most parts of the Presidency, and I think, the future operations should be confined to the Government farms in order to ascertain whether—

"(1) the plant can compete with the ordinary plantain—**Musa paradisiaca**;

"(2) the difficulty of extracting the fibre can be overcome so as to make its production cheaper than the purchase of imported Manilla hemp;
"(3) the fruit can be utilised;
"(4) a hybrid variety can be raised between the **Musa textilis** and the **M. paradisiaca**, useful both as a fruit and a fibre."

Mr. Robertson, of the Saidapet Experimental Farm, reports that the plants will not grow well unless planted in a deep well-manured soil, under regular irrigation. On this account th cost of growing the plants until they reach the stage of cutting is great. He further adds: "There seems little or no probability of **Musa textilis** becoming an established crop on this side of India. On the western coast, in some localities where irrigation and manuring are less urgently needed, the cost of producing the plants will be much less; and there some experiments should be tried." He further states that "there is no probability of really clean fibre being turned out by the ordinary process, at a cost less than 6 annas per pound, a cost far in excess of the value of the fibre."

The cultivation of **Musa textilis** in the Andaman Islands would appear from the reports furnished by the local authorities and by the Agri.-Horticultural Society of India to have been eminently successful, the methods of separating the fibre being alone defective, since the article could only be produced at a price far above its mercantile value. How far this will prove insuperable must be left for further experiments, with improved machinery, to reveal, but it would seem desirable to guard against too high expectations as to any part of India being ever likely to become a formidable rival to the Philippine Islands in meeting the present comparatively limited demand for the fibre.

The cultivation of the Manilla-hemp continues to be prosecuted in the Andaman Islands as will be seen from the following letter:—

No. 574, dated Port Blair, 2nd July 1888.

From—The Superintendent, Port Blair and Nicobars,

To—The Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT.

I have the honour to report, for the information of the Government of India, that 1,415lb of **Musa textilis** fibre have been manufactured and are ready for export, and that I purpose sending the fibre to Messrs. Williamson Magor & Co., for sale, if it is not desired that it should be otherwise disposed of.

	lb
Knife process	210
Water ,,	1,205
TOTAL	1,415

Memorandum of Proceedings of Government of India regarding Manilla-hemp.

1877. Proceedings, No. 5, page 35. Brief notice regarding Bombay.
1877. October, Proceedings Nos. 1 to 5. Statement of the imports of **Musa textilis** into each province.
1879. July, Nos. 17-29. Cultivation of — in the Andamans and Madras Presidency.
1880-81. Nos. 28 to 35. Cultivation of — in India, and extraction of its fibre.
1881. July, Nos. 39 to 48. Extraction of fibre from plantain tree and **Musa textilis**.

1881. October, No. 52. Papers on cultivation of Manilla-hemp.
1881. November, Nos. 6 to 11. Cultivation of, and extraction of fibre from—
MSS. 1881. November, Nos. 12 to 16. Notes on — by B. A. Gupte, &c.
MSS. 1882. March, Nos. 16 and 17. Experiments with — by Agri.-Horticultural Society.
MSS. 1882. April, Nos. 85, 86. Supply of — from Port Blair.
MSS. 1882. June, Nos. 27 to 35. Letter No. 455, to Chief Commissioner, Burma.
MSS. 1882. June, Nos. 27 to 35. Letters Nos. 2168 of 1882 and 1139 of 1882.
MSS. 1882. June, Nos. 27 to 35. Office note.
MSS. 1882. June, No. 77. Letter from Superintendent, Port Blair and Nicobars.
1882. July, Nos. 8 and 9. Note on — by L. Liotard, 19th June 1882.
MSS. 1882. September, Nos. 57 to 60. Cultivation of Manilla-hemp in Burma and Assam.
MSS. 1882. December, Nos. 17 to 21. **Musa textilis** (general).
1883. February, Nos. 1 and 2. Second note by L. Liotard, dated 22nd January 1881.
1883. April, No. 1. Failure of Captain Cox in extracting fibre from —.
1884. February, No. 75. Report on result of experiments on cultivation of — in Bengal.
1884. April, Nos. 17 and 18. Cultivation of—
MSS. 1884. June, No. 1. Cultivation of — in Assam.
MSS. 1884. July, Nos. 32 and 33. Instructions as to mode of cultivation.
MSS. 1885. September, Nos. 1 and 2. Valuation report.
1886. March, file No. 8, Nos. 1 to 12. Cultivation of — in the Andamans.
1887. June, Nos. 15 to 20. Letters concerning — in Port Blair and Nicobars.

An extensive early correspondence in Madras dating from 1861 to 1863 inclusive.

Also extensive correspondence in Bombay regarding the same subject.

GEORGE WATT,
Reporter on Economic Products.

Dated Simla, August 1888.

VOL. I.; PART I. (NO. 2); 1888-89.

SELECTIONS FROM THE RECORDS

OF THE

GOVERNMENT OF INDIA,

REVENUE AND AGRICULTURAL DEPARTMENT,

BY THE

REPORTER ON ECONOMIC PRODUCTS.

NOTE.—On Indian Grains, &c., likely to prove suitable for experimental cultivation in Canada.

Written in connection with a correspondence recently before the Government of India.

CANADA. CLIMATE OF:

I venture to think that the suggestion made by Professor Saunders for sending the seeds of plants grown in Spiti and Lahoul to the Dominion of Canada will not be found as hopeful a project as the sending of seeds of plants grown during the winter months at lower altitudes, if not even from some parts of the plains of India. It is proposed to try the Indian seeds in Manitoba and in the plains to the north-west. The following table shows the mean temperature and rainfall of the summer or agricultural months in Manitoba:

	April.	May.	June.	July.	August.	September.	October.
Mean temperature	30·2	51·2	63·6	65·9	64·8	51·3	40·0
„ rainfall ...	0·80	2·72	3·84	2·75	2·12	3·73	0·54

By April the snow disappears and ploughing commences; and by the end of July harvest has generally begun. In September night frosts occur, and often of such severity as to destroy the crops. The farmer of the north-western tracts of Canada has, therefore, to fear more the frosts of spring and autumn than the extremes of climatic changes between summer and winter. The snow is dry, and although not heavy, it is sufficient to protect fruit trees and winter crops; while the soil is rich and warm, and the summer nights have refreshing dews. Thus the agricultural season may be said to be from the latter end of April to the middle or end of August. There is a sudden rise in temperature and rainfall in May, the temperature steadily increasing until July and August.

In India we have two crops, the *rabi* or spring crop, and the *kharif* or autumn. The former is sown in October and November, and ripens in February to March; the latter is sown and reaped in the intervening months. The crops of the plains of India that might prove useful in Canada would, therefore, be some of the spring crops of the Panjab that mature in from three to four months. The depression of temperature in the middle of the *rabi* season might preclude crops that require a longer period, such as plains' wheat; but the minor crops that are sown in December and January and ripen in March to April are grown under a climate like that of Canada, *viz.*, with an increasing temperature till harvest time. The autumn crops of the plains would be altogether unserviceable. This distinction of *rabi* and *kharif* seasons prevails throughout the lower Himálaya, the effects of a marked rainy season overcoming to a certain extent the influences of temperature. Above 10,000 feet the shortness of the warm weather and less monsoon influences force a summer season crop, which in some respects resembles that of Canada; but the cultivation above that altitude is scanty and poor, so that it is doubtful whether any crops occur in Spiti and Lahoul (the regions specially mentioned by Professor Saunders, and which are above 10,000 feet in altitude) that would be worth sending to Canada, excepting the wheat and barley of those localities.

suitable for Canada.

The following table displays the temperature and rainfall of four stations on the Panjab Himálaya, two on the outer, and two on the inner ranges :

CORRESPONDING CLIMATES IN INDIA.

	Usual Rabi Season.						Usual Kharif Season.												Altitude above the sea.
	October.		November.		December.		January.		February.		March.		April.		May.		June.		July.		August.		September.		
	Mean average Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Feet.
Leh ...	40·1	0·42	30·5	0·03	23·2	0·08	17·5	0·23	19·3	0·23	*31·0	0·19	40·8	0·09	47·1	0·10	56·0	0·20	*61·6	0·46	*60·2	0·40	53·4	0·13	11,500
Kailang ...	42·1	0·40	32·0	0·65	24·1	0·60	21·2	4·87	18·3	3·07	*29·2	3·32	36·4	3·34	45·8	1·72	54·1	1·20	*61·1	0·95	*60·3	0·87	54·4	0·66	10,000
Simla ...	55·9	1·37	48·8	0·33	44·8	1·06	*40·6	2·84	41·1	2·71	49·5	3·02	58·4	2·82	*63·4	4·67	*67·1	7·87	64·2	19·30	63·9	18·12	61·4	6·02	7,000
Murree ...	58·4	2·18	49·1	1·72	43·3	1·21	*38·8	2·78	38·7	3·40	48·4	3·70	57·0	4·27	*64·5	3·80	*71·3	2·43	68·3	10·98	66·5	14·01	65·1	6·09	6,300
Multan ...	77·2	0·11	*66·1	0·07	56·6	0·25	54·6	0·39	58·3	0·27	*70·3	0·51	79·7	0·34	88·7	0·48	93·9	0·39	91·6	2·21	89·2	1·26	86·6	0·78	420
Malkot ...	71·8	0·66	*62·1	0·38	53·2	0·84	53·2	1·41	56·0	1·78	*65·7	1·86	77·0	1·63	84·9	1·15	90·7	3·19	86·61	11·58	85·2	9·13	83·1	3·24	860
Pithoragarh (East of Almorah in Kumaon).	*64·1	1·32	57·1	0·05	52·3	0·79	48·7	1·83	50·3	2·38	59·0	2·11	*67·0	1·39	*68·2	3·34	71·4	7·32	71·1	12·71	70·3	11·02	69·8	4·83	5,300

CORRESPONDING CLIMATES IN INDIA.

Of the stations situated on the inner ranges, Kailang (the capital of Upper Lahoul) is on the one side or to the south of Spiti, and Leh, on the Indus across the middle or great Himálaya, is to the north of Spiti. The climate of Spiti is not systematically recorded, and hence the selection of Kailang and Leh. But it is believed these two points will exhibit the characteristic features of the higher Himálayan regions specially mentioned by Professor Saunders—or the Himálayan regions that have, as a rule, only one crop a year. Zanscar, to which the Professor alludes, is an unimportant valley between the two points selected.

Simla and Murree on the outer ranges may be accepted as representing the Himálayan tracts that have both a spring and an autumn crop. Of the Panjab plains, Sialkot and Multan have been chosen as having during the winter and spring seasons a climate that closely resembles the summer of Manitoba; while Pithoragarh in Kumaon (in the North-Western Provinces) is intermediate between the plains and the higher Himálayan regions where a fairly good agricultural system prevails.

* See seasons bracketed on table, page 8.

A comparison of these tables* of temperature and rainfall will show that the crops that mature in Leh and Kailang during July and August might be sent to Canada; that practically all the crops grown in Murree and Simla, but more especially those sown and reaped from January to June, might also be sent; that, of Multan and Sialkot it would be safe to send only the crops reaped in early spring, *e.g.*, those sown in October and November and reaped in March; and that of Pithoragarh, all the crops that are sown in October to January and reaped in April to May might be sent. It will be thus observed that in the regions named both rainfall and temperature approximate, during the periods specified above, to those of Canada; so that the number of Indian Agricultural Products which might be grown in Canada is increased very considerably beyond the list that could be furnished were attention to be confined solely to Spiti, Lahoul, and Zanscar.

The following are the principal crops that might be sent to Canada, grouped under four heads, obtained by reducing the seven regions discussed above to four. Thus by uniting Leh and Kailang into one, we have a representation of the upper Agricultural Himálayan region; Simla and Murree corresponding to the second or intermediate Himálayan region; Pithoragarh to the third or Lower Himálayan region; and Multan and Sialkot to the fourth, or the division of the plains which possesses crops that might be found suitable for Canada. The high rainfall in the countries to the east and south-east of Kumaon would render it in all probability hopeless to procure crops from those parts of India, even although in point of temperature they may have a winter climate not unlike the summer of considerable portions of Canada.

1—THE CHIEF CROPS OF THE HIGHER NORTH-WESTERN HIMÁLAYAN REGIONS THAT MIGHT BE FOUND SUITABLE FOR NORTH-WEST CANADA.

In the upper tracts of Lahoul only one crop is got; it is sown in May and reaped in September. The crop consists of barley, wheat, and buck-wheat—barley being the chief. But Lahoul is not self-supporting, although Spiti is; wheat, barley, and rice are regularly imported from Kulu. There are no vegetables or minor crops grown in Lahoul except buck-wheat; but in Spiti, where buck-wheat is scarcely grown, peas are cultivated to a certain extent.

suitable for Canada.

TEMPERATE CROPS.

1st, WHEAT.—There is said to be grown a peculiar form, with six tiers of grains to each ear; this is met with in the district of Patten in Lahoul and from Kibbar downwards to Spiti.

2nd, BARLEY.—In some parts of Lahoul a double harvest is got, barley occupying the soil for only about ten weeks. This form of barley is known as *tangsad*, and is probably the best form to send to Canada. It is followed by the form of buck-wheat known as *bosotan*. This ripens in two months. In bad years the buck-wheat does not ripen, so that the practice of taking only one crop is considered safer; a barley which requires a longer time to ripen is in that case sown in one field and the ordinary form of buck-wheat in another, both sowings occurring in May. Parched barley-flour made into porridge is the every-day food of the people of Spiti. It is also eaten boiled with butter and green herbs into a kind of soup; wheat flour is generally eaten in this way in Lahoul.

3rd, BUCK-WHEAT.—There are two species of this grain grown in the Himalaya, with perhaps several cultivated forms under each, which are known to the hill tribes. The species are (*a*) **Fagopyrum esculentum** and (*b*) **F. tataricum.** Much confusion exists in the vernacular names given to these plants, and it is probable that the *orgal* or *darán* (referred, by Stewart, to **F. emarginatum**—a form now reduced to **F. esculentum**—) may be **F. tataricum.** Stewart gives the following Panjab vernacular names for **F. esculentum**—*Kála trúmba; Chín*, in the Jhelam basin (*Chín, China* or *Chéna* is by most authors given to **Panicum miliaceum**), *Karma, bres, katú, brapú drawo* in the Chenab; *Bres, katú, phaphra* in the Ravi; *Káthú* in the Bias; *Brus pháphrá, ugoúgal, tsábri* in the Sutlej, *Káthú tráo*, in Spiti; *Tráo, rjao*, in Ladak; *Kaspat* in the Panjab—the bazar name.

For the other form most of the above names are also given, but *orgal* or *úgal* seems more frequently applied to it.

Buck-wheat may be said to be the staple food with the Lahoulis; it is boiled whole and eaten as gruel, or roasted and made into flour, which is then baked into cakes and mixed with *chawg* beer and formed into dumplings.

4th.—The inferior MILLET—*Chína* or (*Chéna?*)—**Panicum miliaceum**—is said to be grown to a small extent in Spiti. But up to 7,000 feet most of the millets are also grown, and it may be doubted which might succeed best in Canada. Seed should be got in Kulu or Simla.

There are no fruit trees to speak of in Upper Lahoul and Spiti; the Apricot grows, but does not seem to fruit well; and the same remark may be made of the Walnut. Both these fruits might, however, succeed in Canada; and although they doubtless are there already, our higher Himálayan kinds might prove better suited to the colder tracts of Canada than the European forms of these fruits which are generally cultivated in Canada and America. The Himálayan horse-chestnut would also probably thrive; the fruits of the last mentioned tree are in the Himálayan tract sometimes used to feed horses.

The system of cultivation pursued in Lahoul and Spiti is simple, and the produce not of the first quality. The field is artificially irrigated; when the water has soaked in, the seed is scattered broadcast and ploughed. Except perhaps a little weeding, nothing more is done, although every now and then as required the field is flooded from the neighbouring rivulet. The irrigation pursued in these higher Himálayan tracts would perhaps not be so necessary in Canada, since in the latter country the rainfall is greater than in Lahoul and Spiti. Imported rice is used along

TEMPERATE CROPS.

with barley in the brewing of the beer known as *chawg*. Many wild plants are eaten as vegetables, but none are cultivated. Thus there is nothing of much value in Lahoul; but passing lower down the hills into Upper Kulu, there are crops of greater importance which may be added to the above. About 24 per cent. of the cultivated area of Kulu produces two crops; but although every field is not twice cropped, there is both a *kharif* and a *rabi* season. A spring or *rabi* crop is rarely grown in land to be cultivated in the *kharif* season with rice; of the *rabi* crop, 92 per cent. consists of wheat and barley in the proportion of 3 of the former to 1 of the latter. Of the remaining acreage, 5 per cent. is under poppy, and 1 per cent. under tobacco, leaving 2 per cent. for lentils and oilseeds. Of the autumn or *kharif* crop, 83 per cent. consists of the following crops: rice 25 per cent., maize 12 per cent., *sariári* (**Amarantus paniculatus**) 14 per cent. The last-mentioned plant is known around Simla as *báthu* or *chau*. *Kodra* (**Eleusine corocana**) 8 per cent., *Káthú* (**Fagopyrum esculentum**) 6 per cent. *Kodra* is one of the grains from which *Sur* (spirits) or *lugri* (beer) is commonly made; bread is also prepared from its flour; but for the purpose of Canadian cultivation, it may be doubted whether the Amarantus, Buck-wheat or Millets would ever likely meet with favour. They do not yield grains which Europeans would seem likely to eat readily, and it would therefore be desirable to send such crops as might be expected to meet with favour. Among these an important place should be given to—

5th.—Rice (**Oryza sativa**).—This is the most important of the autumn crops in Kulu, but it can only be grown where water is plentiful. All irrigated land is devoted to this crop. The rice is first sown in flooded nurseries, and, then transplanted when some seven or eight inches in height. It is dibbled into the inundated ground, the plants being about six inches apart each way, and the field kept flooded for at least two months afterwards. There are three forms of rice met with in Kulu; and these are known as *básmatí*, *jatu* and *sukadas*, the first-mentioned being the finest and most expensive kind. But the rice from Yarkand would succeed far more likely in Canada than any Indian form. The winter in Yarkand is too severe for wheat and barley to be sown in autumn, but a summer wheat, barley and rice are sown, and may be seen being reaped in adjacent fields.

These remarks regarding rice are equally applicable to the hill rices of Simla, Murree, and Pithoragarh, although it is probable that the rices from the higher altitudes of Kulu would be preferable to any others. In most parts of India a rice, is known as the 60 days' rice, because it only occupies the soil for that period. It is not known whether a form exists on the hills that possesses this property; but such rice, if it does exist at high altitudes, would be preferable for Canada to any other. Plains' rice would in all probability be quite unsuited, unless Sialkot or Multan possesses a form grown in sixty days during the coldest month.

6th.—Pulses.—There are several pulses grown at Kulu, and most of these would succeed well in Canada; but it is probable those from the plains or lower hills would grow equally well. In Kulu the following are grown: *Kult* (**Dolichos biflorus**); *mah* (**Phaseolus radiatus**); *matar* or *kalon* (**Pisum arvense**); *masur* (lentils, **Ervum Lens**); gram, *cholá* (**Cicer arietinum**). **Glycine Soja**, the Soy bean, is said to be grown in Yarkand, and would perhaps do in Canada, if seed from Alpine stock were procured. Of the pulses, perhaps none would be so much appreciated as gram. Experiment alone will determine whether it will succeed; but, as a cold season crop, it is grown throughout India, and in Kulu it is also cultivated as a *rabi*

TEMPERATE CROPS.

crop; so that it seems possible it would succeed well enough in Canada, if seed from Simla or Kulu were procured. The form most likely to prove suitable is the white kind, generally known as Kabuli; but there is a truly Alpine species, **Cicer soongaricum**—a pure white seed much appreciated in India for sweetmeats; and this is grown at altitudes from 4 to 12,000 feet, chiefly in Kulu and Ladak.

7th.—MAIZE or Indian Corn.—This is a comparatively recent crop in India, having come originally from America; but, as the result of Indian cultivation, several well-marked forms have been produced, the most striking being those which grow high up the Himálayas. It is doubtful, however, if even these would succeed in Canada; but as the grain could easily be procured in Simla, or, better still, in Kulu, it might be worth while sending a selection of samples. Maize from the plains would be quite useless; but, if procurable, Yarkand stock would be better than Himálayan.

8th.—In Kulu and in most parts of the hill stations **Ipomœa Batatas**, sweet potatoes, are grown. In Kulu they are known as *Kachálú*. It seems probable these may have been introduced into Canada already; but if not, they might be worth trying.

9th.—The Jerusalem Artichoke (**Helianthus tuberosus**) grows so freely at 8,000 feet in Simla, that it is perhaps worth while mentioning it in this list. Potatoes are also of course grown all over the hills, even up to 12,000 feet at Kailang. An indigenous tuber that is even more extensively grown may be added to the above list of higher Himálayan products, namely—

10th.—**Colocasia antiquorum**, the *ghuiya*, an aroid, the corms of which are largely eaten by the hill tribes, and grown up to 9,000 feet in altitude. After boiling, they are rendered wholesome, especially if a little acid be added to the water, in order to dissolve the mechanically poisonous crystals which are contained in the cells of most aroids.

II.—THE INTERMEDIATE HIMÁLAYAN REGION.

(REPRESENTED IN THESE NOTES BY SIMLA AND MURREE).

Having included Kulu in the previous remarks, the plants of the present region have been practically disposed of. Millets, rice, and pulses occupy the land after the removal of the *rabi* (or winter) wheat and barley. It is commonly stated that several forms of **Chenopodium** are grown at high altitudes in Lahoul. This may be the case; but they seem more prevalent at about 7,000 to 9,000 feet. They are sown about midsummer, and ripen in autumn.

11th.—**Chenopodium album**, the *bethu-sag* of the plains of India; the *gau-sag, lunak, ırr,* or *kálá báthu* of the Panjab hills; and the *em* of Ladak—yields a small grain; but the leaves are also eaten as a spinach. There are many very distinct varieties.

III.—THE LOWER HIMALÁYAN REGIONS.

In addition to what has been said regarding Kulu and Simla rices, it may be here added that some of the forms of Kumaon rice hold a high place in point of quality. The *básmatí* and *hunsraj* rices of Kumaon sell for 5 to 6 seers (12lbs.) for the rupee (2 shillings). The wheat of this region also might be sent with some hope of its succeeding. Millets, pulses, and ground tubers and bulbs are also extensively grown, as well as a large number of forms of gourds, pumpkins, melons, and cucumbers. The cucumbers of the lower hills attain a large size (? according to some writers,

these are melons, not cucumbers), and with the hill tribes constitute an important article of diet. Although Canada already possesses a large number of these vegetables, it is probable that some of the Indian forms would be esteemed as valuable *additions*. The seed might be procured from Kumaon. The Soy bean (**Glycine Soja**, or *bhut*) is largely grown, and ripens in October. This is perhaps the most nutritious of all pulses, and the one that hitherto has commended itself most to Europe. It seems probable that Canada would be found too cold for it; but seed might be procured in Kumaon, both of the black and of the white variety.

IV.—THE PLAINS.

The above remarks have to a large extent covered all that need be said here. It seems very doubtful if any of the plains' wheat, rice, or barley would grow in Canada; but any of the other minor *rabi* crops which are sown in December and January, and ripen in March or April, might be added to the list given, such as the *rabi* pulses, more particularly gram and glycine. It seems probable that of all the crops recommended, gram (especially the white or Kabuli form—**Cicer soongaricum**) stands the best chance of proving useful, and therefore seed from all four regions might be furnished of that plant.

SIMLA, GEORGE WATT,

21st May, 1888. *Reporter on Economic Products.*

VOL. I.; PART I. (No. 3): 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

Wool-Production, Consumption and Trade in India.

PREFATORY NOTE.

The information contained in these pages has been collected with the object of supplementing the particulars regarding wool furnished in the Monograph on Woollen Manufactures of the Punjab in 1884-85 by Mr. D. C. Johnstone (Assistant Commissioner) which was published by the Government of the Punjab.

Production.

2. It is very difficult, with the imperfect and incomplete statistics we have of the agricultural live stock of this country, to estimate even approximately what is the total wool-production of India. Mr. Orrah, Deputy Superintendent of the Bhaugulpore Jail, in his letter, dated the 15th June 1887, addressed to the Director of Land Records and Agriculture, Bengal, states (page 37 of the appended Collection) that it is calculated that 30 million sheep yield on an average 111 million lb wool or about 4 lb of wool to the fleece. These figures refer, it is presumed, to the whole of India, as they can hardly be intended for Bengal alone. Mr. Orrah's estimated production appears to have been pitched too high: he puts the average yield per sheep at 4 lb: this is the average for England where it varies from 10 and even 12 lb for the merino sheep to 1½ lb for an animal from Hereford (*vide* Dr. Hendley's report, page 25 of the appended Collection). In India sheep are, generally speaking, sheared twice a year, *viz.*, once in spring (March-April) and again in autumn (October-November); and at each shearing not more

Consumption.

than a pound on an average is obtained from each sheep, so that the annual yield per sheep is about 2 lb: that this quantity is not more is natural in a country where the climate is warm and where the animals receive less care and attention than in the United Kingdom. Assuming the average yield per sheep to be 2 lb, the total production in India would be 60 million lb, *i.e.*, 30* million sheep (which number may be accepted as approximately correct) × 2 lb; but to this something must be added, as in speaking of wool in this country the term is used in its widest sense so as to include the fleece of sheep, goats and even camels. Adding 20 per cent., which perhaps is a reasonable margin to allow, we get 60 + 12 = 72 million lb as the total production of all kinds of wool; and allowing for *net* exports from India the remainder would give a consumption of $\frac{1}{5}$th of a lb per head of population in India, the population being reckoned at 250 million people. In England the consumption per head is estimated at $2\frac{1}{2}$ lb, but it can be nothing like this figure out here where the consumption to any appreciable extent may be said to be practically limited to the region which would be above a line drawn from the north of Bombay to the west of Patna. Outside that region cotton takes the place of wool in the shape of padded coats or quilts. The manufactures of wool by natives consist mostly of shawls, coarse cloths, blankets, carpets, rugs, felts, saddle cloths, packs for bullocks and ropes. The working up of the finer materials under European supervision into blankets, serges, broadcloth, &c., is confined to the mills in Bombay, Dhariwal (Punjab), Cawnpore (North-Western Provinces and Oudh), and Bangalore (Mysore).

Trade. Frontier Trade. Imports.

3. India received on an average during the last three years $10\frac{1}{2}$ million lb, valued at R$15\frac{3}{4}$ lakhs from across the frontier by land. The chief sources of supply are Afghanistan (Kabul and Kandahar), Beluchistan (Khelat and Lus Bela), and Tibet, the percentage contributed by each to the total imports being 61, 25, and 4 respectively. The importing Provinces are Sindh, the Punjab, North-Western Provinces and Oudh, and Bengal, the proportion taken by each being 82·6, 13·2, 2·2, and 2 per cent. respectively. The imports into Sindh are mostly for shipment, while those into the other Provinces are chiefly for home consumption. Kandahar and Beluchistan supply Sindh; Kabul, the Punjab; and Tibet, the North-Western Provinces and Oudh and Bengal in about equal proportions. About six or seven months ago enquiries were made in Parliament regarding the development of the wool trade between Bengal and Tibet by increasing the supply and improving the quality of Tibetan wool which realizes four times the price of any other wool. It will be seen from what has been stated above and from the correspondence with the Director of Land Records and

* In the return of Agricultural Stock for 1886-87 the number of sheep and goats is entered as $25\frac{1}{2}$ millions, but this is exclusive of the Central Provinces and Bengal for which figures are not available at present.

Agriculture, Bengal (*vide* pages 31 to 34 of the printed Selections), that the trade between Bengal and Tibet, although capable of considerable development, is at present insignificant, hardly amounting to 200,000 lb, and that it will remain so until the restrictions imposed on trade at the frontier by Tibetan officials are removed and a regular demand there is ensured. The efforts hitherto made to develope this trade have met with little or no success. The imports during the current year have collapsed owing to political complications on the frontier.

4. The arrivals of foreign wools in India have been increasing considerably during the last four or five years, having risen from $7\frac{1}{6}$ million lb in 1884-85 to $12\frac{1}{6}$ million lb in 1887-88, the latter being the highest quantity on record during the last ten years; and they continue to augment as will be seen from the imports given on the margin for the five months ending August (later figures have not yet been published) of the last three years. The expansion of this trade is due partly to the opening of the Sindh-Pishin Railway by which $7\frac{1}{3}$ million lb of wool were received in 1887-88 as compared with $1\frac{1}{10}$ million lb in 1880-81 or six years ago when the line was first constructed; and to a greater extent to the steadily increasing direct shipments from Karachi to England owing to this port improving considerably its facilities for cleaning, pressing and preparing wool for the European market and thus decreasing its former large consignments to Bombay for the purpose and cheapening the cost of transit.

	lb
1886-87 . .	784,000
1887-88 . .	2,240,000
1888-89 . .	4,917,000

5. The exports by land to Frontier States are insignificant. Exports.

6. The imports by sea have averaged during the last three years $3\frac{1}{6}$ million lb, valued at R8·3 lakhs. These come from places on or near the Mekran Coast and the Persian Gulf which are largely inhabited by pastoral tribes, and these receipts—like those by land—have also been increasing during the last four years, though not so much; the arrivals in 1887-88 being 3·47 million against 2·59 million lb in 1884-85. All this wool is, practically speaking, taken by Bombay and Karachi, the former receiving at present a little more than the latter. Sea-borne Trade—Imports.

7. The average re-exports of foreign wool for the last three years were nearly 10 million lb, valued at R43·3 lakhs, these being taken almost exclusively by England. Of these re-exports about 70 per cent. proceed from Karachi and 30 per cent. from Bombay. Re-exports.

8. It will thus be seen, that out of the $13\frac{3}{4}$ millon lbs imported by land and sea into India 10 million lb are re-exported, leaving, it would appear at first sight, $3\frac{3}{4}$ million lb for consumption in India, but the quantity is really less, as wool is exported in a state different from that in which it is received in India—having to be cleaned, assorted and pressed at Karachi and Bombay before shipment, but the process is apparently far from thorough judging from the

recent reports from England in which it is stated that the wool received is often loaded so heavily with sand (as much as 70 per cent. at times) that the buyers there are beginning to be very cautious about transacting business in it. Some deduction must also be made owing to the fact that some of the wool is shipped as Indian wool, among the exports of which it thus figures. Most of the foreign wool which remains in the country is consumed in the Punjab, the remainder finding its way to the woollen mills at Bombay, Cawnpore, and Bangalore. A small quantity of Australian wool is imported by the Egerton Mills in the Punjab *viâ* Calcutta, as it is stated that the native wool does not suit some kinds of English machinery. The largest quantity of wool consumed in the country, both foreign and native, is apparently in the Punjab, regarding the manufactures of which Mr. Baden-Powell writes as follows: —

"Woollen fabrics are not much made in the plains, except coarse-blankets. The best come from Rohtak, but the produce of Sirsa and Leia is by no means despicable. Pashmina fabrics, embroidered with silk, and plain pashmina cloths are produced extensively at Amritsar and Ludhiana and a few at Lahore. Shawl-weaving, an art introduced by emigrated colonies of Kashmiris, is practised at the same cities, as also at Nurpur and Admanagar, but with greatest success at Amritsar; none of these articles, however, equal either in the fineness of texture or beauty of colours and design the genuine fabrics of Kashmir. The shawl-weaving of Gujrat and Gurdaspur is quite inferior. In Lahore shawls are made from 'Kabuli' pashm, a wool which is inferior to the Tibetan shawl-wool. These shawls are plain and not patterned like others. They are called 'Lahori Chaddars:' the wool is the produce of the 'Dumba sheep.' (Pages VII and VIII, Vol. I, Punjab Products, 1868.)"

9. It is stated that the imports of the true pashm or Tibetan shawl-wool into the Punjab are being displaced by those of the inferior pashm, the latter owing to its cheapness being the most popular in the markets of the present day.

Export of Indian wool.

10. The exports of Indian wool as returned during the last three years were on an average 23⅔ million lb (valued at ₹91·4 lakhs), towards which Bombay contributed 72 per cent. and Karachi 27 per cent. Bombay draws somewhat largely from Sindh, its imports in the three years 1884-85, 1885-86, and 1886-87 being respectively 8·21, 7·58 and 3·72 million lb: these figures show that Karachi is now, as stated before, exporting wool more largely direct to England instead of sending it away to Bombay to be prepared for shipment. The figures given on the margin showing the exports by sea from Bombay and Karachi, during the six years 1882-83 to 1887-88, indicate the same tendency on the part of Karachi.

Year.	*Bombay.* Million lb.	*Karachi.* Million lb.
1882-83	19·6	1·9
1883-84	16·5	3·4
1884-85	15·3	3·6
1885-86	17·3	5·8
1886-87	17·1	5·9
1887-88	16·2	7·3

11. The total shipments of Indian wool have increased but slightly in quantity during the past three years, having risen from 23·1 million in 1885-86 to 23·9 million lb in 1887-88, though

in value they show an increase of ₹10 lakhs, better prices being obtainable. On the other hand, the re-exports of foreign wool advanced in quantity from 8·1 million to 11·2 million lb and in value by ₹19 lakhs during the same period. Evidently the growing demand for wool from India is being met by increasing supplies, not of the indigenous article, but of foreign wools from Persia and the Frontier States, the chief entrepôt for this trade being, as shown before, Karachi. It seems doubtful whether the export of Indian wool will ever increase materially owing to the supply being limited. Much of the wool that is produced is required for local consumption. Besides, the production is believed to be contracting in consequence of diminishing grazing areas caused by the extension of cultivation. The grazing in forests is also becoming somewhat restricted.

12. England is also the largest customer in the case of the exports of Indian wool which is there worked up into carpets, rugs and blankets. At present India plays a somewhat unimportant part as compared with Australia in supplying England with wool, as out of an average import of 555 million lb during the last three years Australia contributed 68·5 and India only 5·6 per cent.

13. The following table shows the imports of wool (both Foreign and Indian, no distinction between the two being made at present) into Bombay and Karachi by rail during the year 1887-88 and the sources of these imports. The arrivals by rail of wool at the other sea-ports are insignificant:— Imports into Bombay and Karachi by rail.

Whence exported.	Imported into		Total.
	Bombay.	Karachi.	
	Million lb.	Million lb.	Million lb.
Bombay	2·32	...	2·32
Sindh	...	3·84	3·84
Punjab	2·24	8·24	10·48
Rajputana and Central India .	5·36	...	5·36
Total .	9·92	12·08	22·00

In Bombay wool is largely produced in the Deccan; and sheep and goats are said to abound in certain parts of Sindh. In the Punjab a small part of the exports is drawn from the great sheep-breeding district of Hissar, but by far the greater portion is reported to comprise the produce of the adjoining tracts in Rajputana and of the Himalayas and the Trans-Himalayas. Looking to the fact that the Punjab receives from Frontier States not more than 1¼ million lb yearly, it would appear that about 60 per cent. of the imports by rail into Bombay and Karachi consists of the produce of Rajputana alone, and there seems no reason to doubt this, as judging from the reports printed in the appended collection (pages 24-31),

Rajputana is evidently a large wool-producing country. In England, Rajputana wool is chiefly utilized in making carpets.

Prospects of the wool-trade.

14. The trade in wool in India is important, and can be largely developed if woollen manufactures are taken up extensively out here and greater facilities are afforded for importing foreign wool from across the frontier. In Bombay the increasing demand for woollen piece-goods is said to be engaging the attention of manufacturers there, so much so, that one woollen mill is in course of construction and three or four more are contemplated. At present some of the cotton mills in the Presidency are engaged to some trifling extent in the manufacture of woollen goods in addition to their ordinary business. According to the Statistical Tables for British India (Twelfth Issue) published last year by the Department of Finance and Commerce "there are four woollen mills, *viz.*:—two at Cawnpore, one in the Punjab at Dhariwal, in the Gurdaspore district, and one at Bangalore. One of the Cawnpore mills is a private concern; the other three are Joint Stock Companies, with an aggregate nominal capital of 18 lakhs. The Dhariwal Mill does not state its outturn: the other three report an outturn of the aggregate value of 5¼ lakhs in 1886, against 7¼ lakhs in the preceding year, and 3⅓ lakhs in 1884. The number of looms and spindles employed in 1886 by the three mills was 242 and 5,420."

REV. & AGRI. DEPT.; *The 27th December 1888.*

F. M. W. SCHOFIELD.

CONTENTS OF No. 3.

Note on Wool-Production, Consumption and Trade in India.

		PAGE.
From Lt.-Col D. G. Pitcher, Offg. Director of Land Records and Agriculture, North-Western Provinces and Oudh, to the Government of India, dated 17th March 1887.	Furnishes certain information regarding wool in Oudh . . .	23
Do. Do., dated 26th October 1887, to the Government of India.	Furnishes information in regard to the wool-trade with Tibet . . .	23
Do. Do., No. 4389, dated the 10th November 1887, to the Government of India.	Furnishes information on wool in the North-Western Provinces .	24
Notes on wool and woollen goods in the Jeypore State, by Surgeon-Major T. H. Hendley, Honorary Secretary, Jeypore Museum.	. . . . .	24
Translation of a report from the Council of Bikaneer, to the Officiating Political Agent, Bikaneer, dated 31st March 1887.	Furnishes information regarding the production of wool in the Bikaneer State	26
From Major P. W. Powlett, dated Jodhpur, the 6th April 1887.	Furnishes information regarding the wool-trade in Western Rajputana .	26
From F. Henvey, Esq., C.S., Resident, Jeypore, to the Agent, Governor General, Rajputana, dated Jeypore, 18th April 1887.	Forwards statement from the Jeypore Durbar, giving figures of the Jeypore wool-trade	27
From M. Finucane, Esq., C.S., Director of Land Records and Agriculture, Bengal.	Forwards correspondence regarding wool production and trade in Bengal	31
Reprint of article on Colonial Wools in "Wool and Textile Fabrics."	. . . . .	43
From S. E. J. Clarke, Esq., Secretary, Bengal Chamber of Commerce, dated 28th July 1887.	Forwards report on Tibet wool samples submitted to the Chamber .	46
From Agri-Horticultural Society, to the Director of Land Records and Agriculture, Bengal, dated 30th July 1887.	Report on samples of Tibet wool .	48
From Agent, Elgin Mills, to the Director, Land Records and Agriculture, North-Western Provinces and Oudh, dated 16th August 1887.	Report on Tibet wool samples .	48

From the Manager, Egerton Woollen Mills, to the Director, Land Records and Agriculture, North-Western Provinces and Oudh, dated 17th August 1887.	Report on samples of Tibet wool .	49
From Babu P. C. Ghosha to the Secretary, Agri-Horticultural Society, dated 30th December 1887.	Report on samples of Tibet wool .	49
Letter from the Secretary, Chamber of Commerce, Bengal, to the Government of India, dated 9th March 1888.	Further remarks regarding Tibet wool	50

APPENDIX.

Table of Prices of Wool in England since 1818 to present date 52

FURTHER NOTES AND CORRESPONDENCE

ON

WOOL-PRODUCTION IN INDIA.

Demi-official from LIEUT.-COL. D. G. PITCHER, Offg. Director of Land Records and Agriculture, N.-W. Provinces and Oudh, to the Government of India,—dated Camp Chardah, Bahraich, the 17th March 1887.

OUDH.

Your demi-official, dated 4th February 1887, in regard to wool production in Oudh. I have been making enquiries while on tour through Oudh, and from all I can learn, production, at no time very extensive, has greatly decreased with the extension of cultivation and consequent diminished grazing area.

Wool production diminished.

The whole of that produced is locally woven into coarse blankets. For 1885-86 Oudh exported by rail 36 maunds to Bengal and 71 maunds to Cawnpore. The two Woollen Mills at Cawnpore state that they get no wool from Oudh. I tried three or four years ago to induce the Cawnpore Woollen Mills to procure wool from the pargana in which I am now encamped, once famous for the quality of the blankets woven, but nothing came of it, and I now find that the Gareriyas, or flock-masters, have nearly all cleared out since grazing in the forests has become so restricted, and since cultivation has extended. They have gone over to Nepal.

As with the increase of Indian woollen mills there must be a better price for wool than formerly, it will be interesting to notice whether the recent opening of the Bengal North-Western Railway to Nepalgunge near here, attracts any wool from Nepal. A branch line from Bahraich to Byramghat would very probably stimulate exports and imports to Nepal far more than the present alignment.

Extract from a demi-official letter from LIEUTENANT-COLONEL D. G. PITCHER, dated Srinagar, the 26th October 1887.

N.-W. P.

I have been making enquiries up here about the wool trade. At present but a small quantity is imported from Thibet; but if any firm would take the matter up systematically and make advances, any quantity, they say, can be procured at from R20 to R25 at Josimath, from whence to Najibabad it would cost in carriage another R4 to R5 per maund.

Demi-official from the Assistant Director of Land Records and Agriculture, N.-W. Provinces and Oudh, to the Government of India,—No. 4389, dated Cawnpore, the 10th November 1887.

On receipt of your demi-official, dated 20th May 1887, I consulted the principal correspondents of the Department in all the districts of the provinces about the production and disposal of wool in their districts. From their replies I see that the only part in these provinces which produces any wool worth consideration, is the tract bordering the river Jumna which enjoys large areas of grazing land for rearing sheep. Much of the wool that is produced there is used up locally in the manufacture of *kamals*, *lois*, *numdahs*, &c.

Jumna Wool.

What is left is brought to the Mills at Cawnpore which work about 15,000 maunds annually, fully one-fourth of which is supplied from this tract. The chief source of the supply of wool is the Punjab, which sends about two-thirds of the total quantity consumed at the Mills; a quantity is also received from Rajputana and Nepal. The several varieties command the following prices at Cawnpore :—

Prices of Wool in N.-W. P.

Desi (produced in the provinces) .	R10 to R12 per maund.
Amritsar (Punjab)	„ 14 to „ 15 „
Narnal (Rajputana) . . .	„ 15 to „ 17 „
Nepal	„ 20 to „ 22 „

Note by SURGEON-MAJOR T. H. HENDLEY, Honorary Secretary, Jeypore Museum, on the production of Wool and Woollen Goods in the Jeypore State.

Rajputana Wool

In Jeypore, sheep are principally reared by Gujars and Jats. In ancient times, Northern Jeypore, or at all events, that part of it which was included in Virata (Bairat), was famous as a sheep-producing country, and even now it is stated in the *Rajputana Gazetteer* that the principal export from Shekawati or North Jeypore, is wool. The best wool, however, is said to come from the western border, which is not indeed as good as that from Marwar and Bikaneer; good wool is also obtained at or near Malpura, south-west of Jeypore City, the seat of the *numdah* or felt industry.

JEYPORE.

Sheep are kept in most villages and the wool is bought up by dealers and the *Namadgars* or felters, who may be either Musulmans or Hindus. *Khatiks* or butchers also sell the wool from dead or slaughtered animals, which being inferior in quality (khos-ki-un) is only used for making coarse felts. There are about 40 families of Namadgars, Musulmans, living in the Namadgar-ka-Mohalla, Jeypore City. About 15 families of Khatiks, who live near the old Kotwali, also deal and work in wool. The census return does not give particulars under this head for either the State or Capital.

Spring and Autumn Wool.

Sheep, and even lambs, are shorn twice a year, in the months of Chaitra (March—April) and Kartik (October—November). The wool obtained in the spring is white, that in the autumn yellowish in colour, owing to its having been worn in the rainy season. The Namadgars wash the coarse wool and carefully clean it in a cotton-

JEYPORE.

cleaning machine. They tread the wool repeatedly in soap and water in large pans and squeeze it into balls which, after drying in the sun, are cleaned by the Pindara or cotton-cleaner with his bow or "tant," or with a machine.

The Superintendent of the Jeypore Jail, who until recently bought wool in the Jeypore bazar for carpet-making, has now purchased it from Sambhur through an agent who obtains it from the neighbouring villages; the best quality, he adds, comes from beyond the Jodhpore border, but it contains more *barut* or seeds of grass, thus making it difficult to work. Three qualities have been obtained; the last lot cost R14-12-0 per maund against R18 or R19 for wool of similar quality bought at Jeypore. This is the cheapest wool he ever bought in Jeypore. It contains less sand and dirt than usual. Some of the selected wool would be worth from R25 or R30 per maund in Jeypore. It comes in the form of a twisted rope tied in a knot, each piece weighing a little over 8 chittaks (Jeypore weight). The fleece from his own sheep, the wool being coarser, weighed about 8½ chittacks.

From other enquiries, I find that in Jeypore the fleece of a full-grown sheep weighs from ¾ to 1 seer, or 2lb 2oz. In England the average is 4lb to the fleece, varying from 10 and even 12lb from the merino sheep to 1½lb for an animal from Hereford, where wool is fine, as the sheep are kept very clean. In a warm climate it is natural for the fleece to weigh less. Sheep are not dipped before shearing in Jeypore.

I am informed that uncleaned wool may be purchased at rates varying from R10 to R12 or R13 per maund. The wool of dead sheep can be bought for R8 per maund. It is sent in large quantities to Bombay, Nagore in Marwar, and other places.

Chaura-ka-Sarur, about 25 miles from Jeypore towards Shekhawati, is the best sheep-breeding ground in the State.

Uses of Wool in Jeypore.

Felts.

The principal use of wool in Jeypore is to make felt, the *numdahs* or *namads* of Persia, in which country carpets are generally placed in the centre of the room, set, as it were, in a frame-work of soft, thick *namad* or felt. I think there is little doubt that this art was introduced into Rajputana from Persia through Delhi. It is an industry of some importance. At Malpura, the principal seat of it, large numbers of saddle *numdahs* are made for Bengal cavalry regiments, also *gugis* or hooded cloaks for native horsemen and persons who are exposed to wet weather—*asans* or round prayer carpets used by Hindu devotees; the *Jai-nimaz* or Musulman prayer carpet, which is of oblong shape, marked out with a nich in coloured felt, gun covers, *chakmas* or square rugs, and *kamals* or coarse blankets. Some of these felts are remarkably fine and durable. The better kinds are beautifully white, the common ones yellow or dark-grey.

The *namdahs* are thick and fairly waterproof; many of them are tastefully ornamented with small pieces of coloured felt arranged

in artistic designs, and most of the prayer carpets are made in different layers of which the edges are cut into curves and tooth-like projections. Felt is also made at Tonk and in Jeypore.

Blankets. Blankets are manufactured at Hindon, Phagi, Madhorajpura, Choundlai, Chatson, Sambhur, Naraina, Bhandarej, Jobner, Chomu and Samodh.

Cloth. Fine woollen cloths (*lois*) are made in Nagore and Bikaneer not I think, in Jeypore, though I am not quite sure whether coarse examples cannot be had from Losal on the west border.

I cannot discover that any mixed cotton and wool cloths are made here. *Chakmas*, made in the autumn from yellow wool, are sold at ₹17 per maund; the best white ones made at Jeypore cost ₹20 per maund. Tonk *chakmas* of good quality are worth ₹24 per maund. Blankets cost from ₹0-8-0 to ₹1 each.

Translation of a Kaifiat from the Council of Bikaneer by A. P. THORNTON, Esq. Offg. Political Agent, Bikaneer, dated 31st March 1887.

BIKANEER. We have received your Kaifiat, dated 16th March 1887, requesting information regarding production of wool.

Production. In reply, we beg to state that in Sumbat 1942, 15,811 maunds, and in Sumbat 1943, 19,073 maunds of wool was exported from Bikaneer territory; this gives an average of 18,341½ maunds of wool

Trade. exported per year; the amount of produce of wool cannot be approximately estimated, but in Sumbats 1942 and 1943, 1,624 and 1,429 maunds of woollen cloth were exported, and about 2,000 maunds of woollen cloth used in this State, therefore the average produce per year may be taken at 22,000 maunds, including the wool and woollen cloth exported to other territories. The average

Prices. price is ₹20 per maund and ₹2 customs duty; it is exported to Bombay *viâ* Bangla in the Punjab; the state of trade is good because the quantity which remains over the quantity consumed in this State is all sold.

W. RAJPUTANA. Demi-official from MAJOR P. W. POWLETT to Mr. COLVIN,—dated Jodhpore, the 6th April 1887.

As desired in your demi-official of 9th March, I give the following information regarding the wool trade in Western Rajputana.

Marwar Wool. It is not possible to state with any accuracy the gross produce of wool, but for Marwar it may be roughly calculated at 50 to 60 thousand maunds. During the last four years wool has been exported from Marwar to Bombay chiefly by Railway as under :—

Production.

1883-84.	1884-85.	1885-86.	Ten months of 1886-87.
Mds. 39,180	Mds. 32,100	Mds. 43,400	Mds. 43,150

W. RAJPUTANA.

The increase of export in 1885-86 and 1886-87 is attributed to the reduction in October 1884 of the customs duty on wool from R1-4 to half that amount, and the extension of the Jodhpore Railway line from Luni to Pachbhadra, which is to be opened in a few days, will, it is hoped, further stimulate the wool trade of Marwar.

Jeysalmere and Sirohi Wool.

The annual export from Jeysalmere and Sirohi may roughly be taken at 5,000 and 2,500* maunds respectively. Sirohi wool is said to be much inferior in quality to that of Marwar or Jeysalmère, and consequently, while a maund of Sirohi wool seldom fetches more than R7 or R8, the price of same quantity of Marwar or Jeysalmere wool varies from R12 to R25. The best wool is obtained at the second shearing after the cold weather.

Prices.

Statement showing the estimated quantity of wool produce in the Kishengurh State.

JEYPORE.

Estimated produce.	Exported.	Any facts regarding		
		Fabrics locally made.	Prices.	Present State of the trade.
Mds.	Mds.	(1) Ghooghi. (2) Chakma.	Wool is sold at R18 per maund.	A little increase in the trade compared with last year.
1,000	700	(3) Kamal &c.	Kamal, from R1 to R3 per piece. Ghooghi from 8 annas to R2; Ausan from 2 annas to R1; and Chakma from 8 annas to R1 and 4 annas per piece.	

Demi-official from F. HENVEY, Esq., Resident, Jeypore, to the Agent Governor General, Rajputana, —dated Jeypore, the 18th April 1887.

With reference to Mr. Colvin's demi-official letter of 9th March 1887, I enclose a statement showing the figures of the Jeypore wool trade. I asked Babu Kanti Chunder whether he could get me any interesting particulars about woollen fabrics, &c., and he has sent me a note, copy of which also is enclosed.

* To Bombay *viâ* Madar and Pindwara.

Statement showing particulars about the wool annually produced in, and exported from, the Jeypore State.

Average produce for the past three years.	Quantity of wool and woollen fabrics exported.	Route taken by produce.	Localities where fabrics are made.	Principal fabrics made.	Prices of fabrics.	Prices of wool per maund.	Present state of the wool trade.
Mds.	Mds.	Shekhawati to Delhi.					
4,362	3,468	Buswa .	Jeypore . .	Chakma .	As. 4 to R5.	R10-8 in districts and R12-8 in the Jeypore City.	It will appear from the following figures that there has been a gradual decrease, both of produce and export :—
		Mohwa .	Malpoora .	...	...		
		Parasoli .	Hindown .	Ghooghi .	As. 4 to R5.		
		Sambhur .	Gangapore .	...	...		
		Nagar .	Sanganeer .	Dalli .	As. 4 to R1-8.		
		Daber .	Sikandra .	...	...		
		Lamba .	Chaisoo . .	Ausans .	As. 2 to R1.		
		Toda .	Chandloi . .	...	...		
		Newai .	Chomoo . .	Blanket .	R1 to R2.		
			Madhorajpoora				
			Phagi . .				
			Jhalli . .				
			Shekhawati .				

Sambat.	Produce.	Export.
	Mds.	Mds.
1940	5,210	4,363
1941	4,248	3,198
1942	3,628	2,844

NOTE.—This seems to be exclusive of Shekhawati, which is said to produce 1,728 maunds, valued at R32,560.

Explanatory note to accompany figures of wool trade.

JEYPORE WOOLLEN MANUFACTURES.

Chakmas.

Chakma.—A woollen sheet of oblong form, is made of different sizes. It is used for sheltering goods from rain and as a protection from cold, and also to spread on the ground. Ordinary *chakmas* are 2 yards by 1 yard and are sold at about ₹1-8 each. *chakmas* (prepared to order) are used for covering carts, ruths, &c., and can be made of any size as the purchaser may require, varying in prices according to the quantity and quality of wool and evenness of the fabric.

Ghooghis.

Ghooghi—Is a warm covering, worn as a protection against rain and cold wind. It gradually spreads out from the top, which consists of a sort of a hood. *Ghooghis* are of two kinds: one for walking and the other for sowars or horsemen. The length of the one used by people on foot is just sufficient to cover the human body, that of the other used by sowar, serves to cover also the hip of the horse, and its length is always in proportion to its width. *Ghooghis* (made to order) can be prepared up to the value of ₹25.

Ordinary *ghooghis* for walking purposes are sold at ₹1-8 or ₹2 each, those for sowars from ₹3 to ₹5 each, but the price generally varies according to the whiteness and softness of the wool, thickness and evenness of the fabric.

Fabrics made of yellow, uncleaned and coarse wool, uneven in their make, and so thin that they are not water-tight, when turned towards the sun they let the light through and are not good, but those made of white and soft wool, even and thick, are costly.

Dallis.

Dalli.—The length and breadth of the *dalli* are exactly according to the size of saddle or *kathi* under which it is placed to protect the back of the horse from injury, and its price varies according to its thickness, evenness, and the quality of wool of which it is made.

Ausans.

Ausans.—Are of two kinds, square and circular. Square *ausans* are 2 feet square, varying in thickness like that of *chakma* and *ghooghi*. *Ausans* (prepared to order) are 1 inch to 1½ inch thick; circular *ausans* are of different diameters. Ordinary circular *ausans* prepared for sale are generally 2 feet in diameter and are worth about eight annas each. Circular *ausans* (prepared to order) are 1 yard to 1½ yard in diameter and are more costly. Hindus sit on *ausans* when they worship.

These woollen fabrics are often ornamented with borders and flowers of layers of wool worked on the fabrics. Simple borders and flowers are made of white wool of which the fabrics are made, and sometimes pieces of broad-cloth of different colours are cut into flowers and pasted on the fabrics. The *ghooghis* and *chakmas* of Malpura owe their credit to the water of a certain well which gives a peculiar lustre to the fabrics.

The fabrics described above are made of white wool. Black wool is chiefly used for making blankets and grain-sacks.

JEYPORE WOOLLEN MANUFACTURES.

Process of making Chakmas and Ghooghis.

First of all wool is cleaned of all foreign materials and then combed; when it is ready for use, a piece of cloth of the measurement of the fabric to be made is stretched out and the quantity of wool of which it is to be made is spread upon it evenly by a wooden instrument. Wool for preparing *chakmas, ghooghis, &c.*, is spread on low ground, so that the soap water which is required in the process may not uselessly flow away. After the wool has been spread on the measured cloth, water is sprinkled on the wool and then the wool is mixed with soap and water and pressed down with the hands and elbows. This process is technically called "Rudda" which makes the fabric lasting, even and exact to the measure. These fabrics are not made by any machine, but prepared by a peculiar process as follows: The cleaned wool is soaked in an infusion of soap, gum, alum, and water. It is then spread upon the floor over a piece of white cloth in flakes, saturated with the said fluid, forming any shape wanted and beat in with wooden handle until well set. The piece is then soaked again in the same solution and exposed to the sun, after which it is washed smoothly. These fabrics are remarkably tough and impervious to water. About a quarter seer of soap is required in preparing a *chakma* weighing 2 seers.

After the *chakma* and *ghooghi* have been pressed, the water is not wrung out, but they are spread over *pucca* walls or on beams of wood till dry. After the woollen fabrics have been prepared they are smoked with sulphur to make the color bright.

High, dry and sandy places are best suited for breeding of sheep, but clayey and damp soil is not good for them.

In the villages of Malpura, Phagi, Chaksoo, and Dousa wool is produced plentifully, and in the first named village woollen fabrics are made. The sheep are large and good-looking, but wool of superior quality is produced in Shekhawati, and the mutton there is better and more nourishing, because the district is sandy, while Malpura, Dousa, and others are clayey and damp. There are places in Shekhawati, such as Bisas, Ramgarh, and Fatehpur conterminous with Bikaneer territory, which are remarkable for best sheep yielding excellent wool.

Young sheep yield soft and white wool, and as they grow older their wool becomes coarse and yellowish. Superior fabrics are made of soft and white wool and are therefore costly. Inferior fabrics are made of coarse wool obtained from older sheep. Sheep are generally shorn twice a year. In Shekhawati sheep are shorn once at the end of Sawan (July) and again at the end of Phagan (March), because after three months wool is generally full of the thorns and prickles which grow there. In other districts of Jeypore territory wool is shorn at the end of Chait (March) and

JEYPORE WOOLLEN MANUFACTURES.

again at the beginning of Kartik (October). The average quantity of wool obtained from sheep a year weighs 12 chittacks.

Chakmas, Ghooghis, Ausans, &c., are not manufactured in Shekhawati, but the villagers, to meet their own wants, get blankets prepared by Chamars for their use and *dhablas* for their females.

Wool is exported by merchants from Shekhawati to Delhi. The average quantity of wool produced in Shekhawati annually is 1,728 maunds, valued at ₹32,560. The average price of wool sold in Shekhawati district is 2 seers per rupee, while in other districts it is sold at 3 seers per rupee, and the reason for this difference is that Shekhawati yields soft wool and the other districts coarse wool.

BENGAL.

Note on Wool in Bengal by M. FINUCANE Esq., *C.S. Director of Land Records and Agriculture, Bengal.*

The Government of India having asked me, by demi-official communication, for some information regarding the trade in wool in Bengal, and the possibility of improving the supply or quality of that article, I have made some enquiry on the subject. I now give the small amount of information on the subject which I have been able to gather.

First, as regards the supply of wool from Tibet and the Northern Frontier, the following remarks occur in the Report of the External Trade of Bengal with Nepal, Sikkim, and Bhutan, published by the Government of Bengal, 1885:—

"The quantity of wool available for export from Tibet is believed to be enormous. Between Kamba and Shigatse, within a march and a half of the Sikkim frontier at the head of the Lachen, sheep are killed, not for the sake of their hides or fleece, which are practically valueless for want of a market, but in order that their carcasses may be dried into jerket meat and sold for 8 annas each. At Kamba itself carpets and rugs are manufactured of the finest quality, and of patterns evincing excellent taste and skill; but there is no outlet for these fabrics. Further north on the Great Chang Thang (or northern plateau), which begins just beyond the Sanpo, within five marches of the Kongra Lama, are prodigious flocks and herds which roam at will over the endless expanse. In noticing the improvements in the supplies of wool imported into Bengal from Tibet during 1883-84, it was remarked in the report for that year—'it is believed that this trade has dwindled during the current year (1884-85), partly owing to the difficulties placed in the way by Tibetan officials,' the statistics recorded show that the belief was well-founded, for the quantity imported during 1884-85 was only one-tenth that imported during 1883-84, *viz.*, 91 maunds against 911 maunds. With the exception of 19 maunds registered at Rungeet in 1883-84, and 5 maunds in 1882-83, the entire supply during the three years was brought through Pheydong. The value of manufactured woollen goods (chiefly blankets) during 1884-85 was ₹4,415 in excess of the figures of 1883-84, but ₹564 below those of 1882-83. By far the largest are supplies brought *vid* Pheydong."

Sikkim and Tibet Wool Imports.

The following statement shows the quantity of wool imported into British territory from Sikkim and Tibet during the past five years:—

	Maunds.		Maunds.
1882-83 . . .	168	1885-86 . . .	2,555
1883-84 . . .	911	1886-87 . . .	1,933
1884-85 . . .	91		

BENGAL.

The falling off in imports of wool in 1884-85, as compared with the two previous years, has been attributed to the difficulties placed in the way of this trade by Tibetan officials; but though this may be one of the true causes of the decline in question, it is to be noted that the trade appears to have been at all times insignificant and irregular. At the same time that there was a decline in the imports of wool, it is to be observed that there was a very large increase in the imports of other articles, for example, musk and yak tails, which, however, may be accounted for by the greater facility with which, these less bulky articles may be smuggled.

Yaks Tails.

2. Without however questioning the existence or the pernicious effects of restrictions placed by the Tibetan officials on the frontier trade—matters on which I have no knowledge and no special sources of information,—I may say that, having made some enquiry on the subject at Darjeeling, I have not seen or heard anything which would lead me to doubt that a considerable trade in Tibetan wool can be developed even under existing conditions, by simply creating a steady demand and securing a steady sale for the article in Darjeeling. It will be seen from a letter from Mr. Spencer Robinson, which is annexed, that a merchant trading with Tibet has recently offered to deliver to that gentleman in Darjeeling ten thousand maunds of wool, provided he guaranteed the purchase of it at ₹16 per maund. The Tibetans, he adds, will not place any obstacles in the way of allowing the wool to come through. If the wool, as stated, can be delivered at Darjeeling at ₹16 a maund, or say, 3 to 3½ pence per pound, and the wool is worth in England 6½ to 7 pence per pound, as it is believed to be, there would appear to be little doubt that the existence of a steady demand at Darjeeling, or some other place nearer the frontier within British territory, would lead to a steady supply so far as the resources of Tibet allow. I am not here arguing against the desirability of removing trade restriction—a question which does not come within my province, and on which I am not called upon to offer an opinion—but what I am arguing in favour of is the creation of a steady demand for Tibetan wool in Darjeeling by establishing an agency, public or private, for the continuous purchase of it. The attempts being made by Mr. Spencer Robinson, who has, I am informed, much practical knowledge of the subject will, from this point of view, be watched with much interest. It will be seen from the annexed report, with which I have been favoured by the Chamber of Commerce, and from the Secretary of the Agri-Horticultural Society, that Tibetan wool as per sample received from Mr. Spencer Robinson is supposed to be worth 6½ to 7 pence per pound in England, where the price is rapidly rising. If this estimate turns out to be correct, and wool is forthcoming from Tibet in large quantities, as stated to Mr. Spencer Robinson, the importation of wool from Tibet should be a highly remunerative business.

Tibet Wool, Price of.

BENGAL.

3. The following statement shows the exports or imports of wool from and to Calcutta according to the Custom House returns, and statistics of river and rail-borne trade in Bengal since 1881-82:—

Year.	Export. lb	Import. lb	Year.	Export. lb	Import. lb
1881-82	13,446	7,484	1884-85	78,395	21,612
1882-83	2,336	41,617	1885-86	57,595	86,367
1883-84	32,684	19,613			

Trade in Wool.

4. As regards the trade in wool produced in the plains of Bengal, there is very little information available in the records of the Bengal Government, and as the Government of India has called for very early report on the subject, I have not been able to ask local officers for further information regarding it. No attempts have ever been made in Bengal to improve the quantity or quality of wool produced in these provinces. The bare suggestion of the possibility of taking measures with this end in view has been made the subject of gibes and ridicule. It will, however, be seen from the papers annexed that practical men, who have given attention to the subject, are by no means of opinion that nothing can or that nothing ought to be done by Government in this matter. Mr. Abbott, a well-known indigo-planter of Tirhoot, is enthusiastically in favour of endeavouring to improve the breed of Behar sheep by judicious cross-breeding, and is willing himself to undertake the supervision of the experiment on an inexpensive plan, which will be found described in his letter annexed, and Mr. Orrah, Deputy Superintendent of the Bhagulpore Jail, is of the same opinion. I think that Mr. Abbott's plan is an eminently practical one, and that cross-breeding on the lines suggested by him and Mr. Orrah ought to be tried. The Revenue and Agricultural Department of the Government of India may perhaps be in a position to give some assistance and support by supplying merino or other good rams and ewes. I am myself also in communication on the subject with Dr. Greenhill of Calcutta, who has been good enough to volunteer his assistance in the selection and importation of good rams from Australia.

Proposal to improve Bengal stock.

5. I annex some interesting papers with which, through the courtesy of Dr. Lethbridge, I have been favoured by Mr. Orrah.

This gentleman has given much attention to the subject of Indian wool, and probably knows more about it than any official in Bengal. Some of his suggestions for effecting improvements in the quality of Bengal wool, owing no doubt to his want of acquaintance with the actual conditions of Bengal peasant life, are, I think, impracticable; but he agrees with Mr. Abbott in thinking that much may be done by judicious cross-breeding. Mr. Orrah, being in charge of the manufacture of woollen articles in the Bhagulpore Jail, is in a position to offer an opinion of value on the subject, and he bears testimony to the fact that the attempts

BENGAL.

made to improve the breed of sheep in the North-Western Provinces have led to a marked improvement in the quality of the wool of that province, which he says is decidedly superior to that produced in Bengal. Further, he significantly notes that since the system of cross-breeding sheep by continuous importation of fresh stock has ceased in the North-Western Provinces, the quality of the wool produced is there also deteriorating.

6. I regret that I am unable to furnish the Government of India at present with more accurate and detailed information on this subject, and have only two practical suggestions to make with a view to improvement in the supply and quality of wool from Bengal and the northern frontier. These are :—

1st.—That arrangements may be made by which a steady demand and sale can be guaranteed for Tibetan wool in Darjeeling or elsewhere within British territory—such demand will create the supply, and will probably arise without the aid or interference of Government, when it is known that wool is forthcoming. If, in addition to this, the Government of Tibet can be induced to remove restrictions which must, as a matter of course, injuriously affect trade, all the better; but I am not in a position to offer an opinion on this point. Further, it would perhaps be at first desirable to allow specially favourable rates for carriage of wool from Darjeeling by rail to Calcutta, and orders to have this done have, I understand, been recently issued. It would also be well, if possible, to improve the means of communication by road with the Thibetan frontier.

2nd.—That as regards wool produced in the plains of Bengal, the suggestions made by Mr. Abbott for cross-breeding in his letter, which is annexed, be accepted as a tentative measure.

Letter from SPENCER ROBINSON, Esq., to M. FINUCANE, Esq., C.S., dated Teendaria, the 17th July 1887.

1st Shipment of Tibet Wool to England.

I forward two samples of Tibet wool as received from that country. One is ewe wool, the other ram's wool. I have been selecting wool for a Calcutta merchant during the last week, who is sending it home to England. This is the first shipment of wool sent home. I received a valuation on this wool recently, which was 6½ to 7 pence per pound in England.

Tibet.

The wool trade with Tibet can be developed into a large business, and a merchant trading with Tibet offered to deliver me 10,000 maunds of wool in Darjeeling (provided I would guarantee to buy it) at R16 per maund. He states the Tibetans will not place any obstacles in the way of allowing the wool to come through the Passes. He is sending me samples of cloth, &c., purchased by the Tibetans, and wishes me to forward them to English manufacturers and let him know the price of such cloth when landed in Calcutta.

Letter from H. E. ABBOTT, Esq., to M. FINUCANE, Esq., C.S., dated Jaintpur, the 27th June 1887.

BENGAL.

Suffice it then to say, as a commencement of correspondence, that as far as sheep-breeding in Behar is concerned, I live in the very centre of it, and roughly speaking, my tenants own at least a lakh of these useful little animals; but as far as wool or quality of meat goes, they are of the most wretched description, though, like most things indigenous to the country, hardy to a degree. As I told you personally, I am convinced that judicious crossing would prove eminently beneficial (were Australian or British blood imported) to both wool and mutton. I do not think much outside trade is done in the wool line, the shepherds finding a sufficient market at present by weaving it into blankets, which they dispose of locally; but with the railroad now at their doors, the industry only wants encouragement to develop into a very valuable adjunct to the commercial economy of the district. Be it always remembered that the grazing in Behar is for India the best *par excellence*. Sheep during the hot weather are driven to the northern *chours*, when for a mere nominal sum they fairly well keep themselves; while during the rains practical farming-planters are glad enough to let them have the magnificient grazing of the inevitably heavy undergrowth in their indigo lands, charging the value of one sheep in the hundred for the right. Therefore Behar is eminently a country suited to sheep farming, and it behoves Government to improve the breed. Give me a dozen rams and double the number of ewes, allow me R20 a month to keep them up, and I will guarantee to make a present of 90 per cent. of every ram produced in the stock to sheep-farmers in the district, and 50 per cent. of the ewes. Your charge shall be no more than the above R20 as long as I am in the country, and when I leave I will give back to Government the same amount of stock that they handed me, or at the end of five years I will ask no further aid from Government, but will return it in kind the amount of rams and ewes advanced me. I will with pleasure furnish statistics of the entire births, deaths and distribution of the stock: of course you will fully understand that, should the stock die, I have no claim whatever against you as far as the R20 per mensem goes. My mere wish is to show how Government aid, properly applied, can benefit the district at small expense, and be made in the long run almost self-supporting. After a bit, I believe we could make money by letting out the services of the rams. But this must be done gradually, I have already proved that, as far as horses, poultry and dogs are concerned, one can with imported blood and judicious local crossing do very great things in Behar; and as I honestly believe, as far as Bengal is concerned, it could be made the nursery for grain, horses, oil-seeds, sheep, cattle, *et hoc genus omne*, for the whole of Southern India.

BEHAR.

Wool locally consumed.

Behar eminently suited for Sheep Farming.

Proposal to improve the breed.

Imported Rams.

BENGAL.

In such a country as this the encouragement of horse, sheep, and poultry-breeding, of the importation of finer seeds from foreign countries, in fact the entire working up of Behar as a wholesale producer for India, should be the work of the Government at first, and of every Englishman who, like myself, is grateful to it for a happy if an exiled home.

Wrong Experiments.

Many experiments have doubtless been made, but forgive me if I say unhesitatingly they have been, as a rule, made on wrong lines. They are generally made through the means of the temporary Collector of the district, without the smallest effort being made to find whether the gentleman in question has a penchant for this kind of thing. The odds are he has not. Witness the attempt to breed mules in Mozufferpur.

BHAUGULPORE.

Report by MR. ORRAH, *Deputy Superintendent, Central Jail, Bhaugulpore, dated 15th June 1887.*

I have the honour to submit the following report upon Bengal wools, together with extracts.

Wool characteristics.

Regarding the production and improvement of wool grown in Bengal, it will be necessary to enter somewhat minutely into the characteristics of wool, namely—

1st.—Softness.
2nd.—Elasticity.
3rd.—Length of staple.
4th.—Uniformity of staple.
5th.—Fineness.
6th.—Soundness.

Defects of Bengal Wool.

So far as my experience goes in the working of Bengal wools, I find them wanting in all the aforenamed characteristics.

As regards want of softness and elasticity, I attribute this partly to the hardness of the water the sheep may have to drink, being of a limy character. The scarcity of yolk in the fibre, which is the natural reservoir from which the wool fibre gains its character for softness, &c., shows the sheep are not sufficiently and suitably fed. As regards length of staple, uniformity, fineness, and soundness these deficiencies are more the result of want of care and attention to the breeding. Good breeding is undoubtedly the main cause by which sheep of all countries are improved, or for want of it are deteriorated.

Whilst Bengal wools show these deteriorations all round, and contrast very unsatisfactorily with other provinces in the north-west of India, *there is one redeeming feature which is a very valuable one, possessed by the Bengal sheep, and that is they are very receptive, or in other words susceptible of being improved more rapidly than many other classes of sheep.* The Tibet sheep, for instance, will require much more time to eradicate the coarse hairs and kemps out of the fleece than would the Bengal sheep.

Possible improvements.

To improve the quality and quantity of Bengal wool, I will mention a few principal methods of treatment necessary for this

BENGAL.

purpose, for part of which there is some evidence of its having been successful in India as well as other countries.

By attention to Pasturage.

1st. Pasturage.—I have spoken of the water as being hard: this seems to point out that land pasturage over Bengal is of a calcic or lime character,* and would undoubtedly not only account for hardness of water, but the pasturage thereof must contain in its grasses, herbs and trees and vegetation generally, a large proportion of calcium, therefore the food upon which the sheep live and graze must also contain lime and we see, as a natural consequence, that the wool they grow is dry, natureless, stunted, and irregular in staple, harsh in feeling, coarse, brittle, inelastic, whilst the yolk of the fibre is scanty and poor.

By attention to the Water supplied to sheep.

I would therefore suggest that the water which sheep drink should be tested, and if found to be hard, should be treated chemically with a small sprinking of oxalic acid,† *viz.*, 1 oz. of the salt of this acid to 500 gallons of water to deposit the lime of waters drunk by the sheep. The washing water for sheep should also have any lime that exists in it deposited before being used.

Yield of Wool.

Quantity and quality of wool, which is distinguished from the fleshy parts of sheep by the large proportion of sulphur which it contains, is very much affected by the soil upon which the food grows: some soils growing poor grasses keep the sheep grazing thereon lean, and whilst giving finest of wool, yields only 1½lb, but a merino fed upon good pasturage, of chemically treated soils, often gives a fleece weighing 10lb to 11lb. It is calculated that 30,000,000 sheep yield on an average 111,000,000lb wool, or about 4lb of wool to the fleece. This quantity of wool contains 5,000,000lb of *sulphur*, which is of course all extracted from the soil.

Absorption of Gypsum as a manure.

If we suppose this sulphur to exist in, and to be extracted from, the soil in the form of gypsum, then the plants which the sheep live upon must take out from the soil to produce the wool alone 30,000,000lb or 13,000 tons of gypsum. Though the proportion of this gypsum lost by any one sheep farm in a year is comparatively small, yet it is reasonable to believe that by the long growth of wool on land to which nothing is even added, either by art or from natural sources, those grasses must gradually cease to grow in which sulphur most largely abounds, and which therefore from growth of wool—in other words the produce of wool—is likely to diminish by lapse of time where sulphur has for centuries been yearly carried off the land: and again the produce is likely to be increased in amount when such land is dressed with gypsum or other manures in which sulphur naturally exists.‡ This, I believe, could be obtained

* This is doubtful.

† Impracticable, and if practicable, would be dangerous, oxalic acid being a poison.

‡ Gypsum would no doubt be good manure for pasture land, but *beriwallahs* are not likely to use it.

BENGAL.

in a very cheap form from the gas works of the country; some of their waste products containing sulphur in a large degree, such, for instance, as the sulphate of lime, a waste product of these works. There probably also is a natural form of sulphur found in connection with the rock salt districts, as geologically it exists in some form in the same stratification. Iron pyrites also contain sulphur in large proportions. Though not acquainted with all the natural products of India, I am quite sure products could be obtained sufficiently low in rates for manuring purposes. No bones of animals ought to leave India, for its land sadly needs it, being also a valuable manure for sheep farms, in addition to the various dungs of animals of all descriptions. Next, I would suggest as of first importance also that a definite system of cross-breeding should be sustained with rams obtained from pure blood stock. There is, I believe, some difference of opinion amongst flock-owners as to what countries the best rams are obtainable from; but experience has always proved this fact, that the merino ram, whether of European, South African, or Australian breed, is decidedly the best for crossing with Indian sheep.

Bone manure.

Improvement by Cross-breeding.

As success has been obtained by crossing the merino rams of each one of these aforenamed countries with Indian sheep, the aim of flock-owners should be to obtain wools for clothing purposes of a finer quality. This could be accomplished, and some six different qualities be obtained, which would work in combination or serve the special direct purposes of manufacture in general. With this end in view, I would suggest—

1st, With South African breed.

1st.—For producing finest fibres of a felty character, a cross of one South African merino ram, pure bred, with 100 Bengal ewes.

2nd, English.

2nd.—For producing uniformity of lengths of staple, medium fineness, soundness, and elasticity, a cross of an English merino ram, pure bred, with 100 Bengal ewes.

3rd, Australian.

3rd.—For medium qualities and characteristics ranging between Nos. 1 and 2, a cross of one Australian merino ram, pure bred, with 100 Bengal ewes.

4th, Indian.

4th.—For improvement from Indian stock rams for coarser wools and cloths, a cross with North-West part-bred merino rams, the result of crossings with European stock in years gone by. This crossing would give wool closely approaching the Agra wool, or wool used largely by the Cawnpore and Dhariwal Mills, and also exported largely to Europe.

5th, Tibetan.

5th.—I would advise a trial being made of crossing some Tibet ewes with an English merino ram, pure bred, and the rams obtained from this crossing should then be crossed with Bengal ewes. The effect, I believe, would be that a Bengal wool would be produced, having a character

BENGAL.

distinctly its own, and a flannel and clothing wool also suitable for hosiery would be produced of an excellent character and high value.

6th. Australian.

6th.—To produce combing wool of very long, fine staple, soft in form in length, soundness, and elasticity, of a high value, for European combing machinery, would, I believe, be obtained by crossing Australian fine merino ewes, pure bred, with Tibet rams.

Selection of Cross-breeds f Stock.

In connection with this matter of breeding are several important factors, such as the ascertaining of defects, pursuing a good system of selection or rejection and sub-division of sheep into classes. These should be done regularly by a yearly inspection, so as to form correct opinion of the nature and properties of the fleece borne by each, in order that the defective sheep may be removed and never again allowed to mix with those drafted and set apart for the production of fine wool.

White-woolled sheep, free from grey or black, should be kept separate. Black-woolled sheep, free from white or grey, should be kept separate; also the rams of same should be similarly kept separate with their flocks, and not allowed to mix promiscuously. All particoloured sheep should be extirpated.

Mixed wools.

Kemp and hairy wool is very objectionable. Bengal wool is very kempy, that is full of white hairy coarse bristles or hairs which protrude and will not dye or become amenable to any process or operation of improvement. This, however, is the result of deterioration in all its forms, and can only be eradicated by the carrying out of all such operations as are being suggested herein. If only a few kemps be seen in wool, it lowers its value immensely for clothing purposes. Good feeding, protection and breeding will eradicate these objectionable features. Thus it is that changes in the fleeces of sheep are wrought by propagation or crossing of breeds possessing those qualities which it is wished to acquire.

Selection of Stock.

Lord Western, whose interest in the growth and improvement of wool production, years ago records the effect of a union he made with one of his lordship's own merino tups and some East Indian ewes, on which a striking proof was exhibited of the influence of the male upon the progeny, the latter having a fleece infinitely superior to that of the dams. The ram was kept highly fed, and consequently their fleeces became long in fibre, heavy in weight, the breed of the ram being the merino, which is considered the best from which foreign stock can be improved. Purity of blood should be unquestionable, and the result will then be a stronger stamina capable of standing changes of climate better.

It is, however, impossible, in the brief space of a report like this, to enter more fully into the minute details of sheep husbandry. I subjoin, however, a few extracts obtained from my library, which may be of interest in showing what has been done in the past in

BENGAL.

the other Presidencies of India, and which I consider somewhat confirms by facts some of the suggestions herein made.

Superiority of N.-W. P. over Bengal Wool.

Before concluding I might remark, *from my present workings of the North-West of India wools, as compared with Bengal wools, there is so decided a superiority of the North-West wools that I am obliged to use a large proportion to obtain more satisfaction from those who purchase our blankets and cloths, and I have no doubt in my own mind that this same superiority has been given to it by some such early action in the matter of breeding, &c., having been taken by the Government of the North-West of India in the years gone by.*

I am also convinced that Bengal could so improve its wools, and if the system of cross-breeding was kept up continuously might eventually supersede in character the wools of those provinces. I judge also from what I see of the North-West wools, at present there are signs in their wools now that the system of cross-breeding is not being kept up by continuous importations of fresh stock, a very desirable element to sustain and further improve their wools: this I would suggest Bengal should attend to continuously.

Extracts from Reports of early efforts to improve Indian Wool, 1838.

Extracts furnished by MR. ORRAH *regarding early efforts in India to improve the Breed.*

The Cape-bred merino rams have been found to answer for this country (India) better than those imported from England, so much so, that Government have determined henceforth to import only from the Cape, as appears from the memorandum from Mr. Secretary Reid in 1835.

The attention of Government was first directed at the end of 1835 to the improvement of the wool and sheep of Western India. From the information furnished to Government it appears that many parts of the Deccan and Guzerat are very well adapted to sheep

Deccan and Guzerat.

pasture, and that, if the wool of this country, which, though of a very inferior kind finds a ready market, were improved by importing superior sheep, so as to improve the fleece of the country breed, the natives would be greatly benefited. Measures were accordingly adopted by Government to import sheep of a superior breed, and in 1837 a supply of rams and ewes, about 106 in number, of the South-down merino breed, were sent out at a very heavy expense by the Honourable Court under the care of an experienced English shepherd.

60 Rams imported.

About 60 rams and ewes of the Saxon and merino breed were obtained from the Cape of Good Hope where the breed is very fine.

A large supply of sheep (600) was also obtained through the agency of Colonel Pottenger and Captain Burne from Afghanistan and Cabul, and the pastoral districts in the vicinity of the Indus. A small number of sheep was also brought from Bussorah, as it is well known that the breed in that part of the country yields a very fine, lengthy fleece. The sheep obtained from England, the

EARLY EFFORTS TO IMPROVE THE BREED.

Cape and Cabul, have been distributed about the country, and many of them are entrusted to the care of gentlemen who understand the management of this animal, and take an interest in the undertaking. A sheep farm was established at Ahmednugger, and another at the fort of Jooner, where the climate is good and pasturage plentiful, and these farms were entrusted to Mr. J. Webb of the Civil Service, who had a good practical acquaintance with the management of sheep. The natives in the interior, who breed sheep, are supplied from these farms with half-bred lambs and were allowed to send their ewes to the Government. From the experience gained by these practicalists, it was found that the Cape-bred merino sheep were far superior to those bred in England and better adapted to the Indian climate. The English sheep being too large for the slight-made ewes of this country, and are moreover greatly affected by the change in the climate. The Cape sheep are less affected by the climate, and not so subject to disease as those of this country or of England, while their lambs are much stronger than those produced from the English sheep. It was therefore determined not to obtain any more supplies from England.

Results recorded.

Of this enterprise on the part of the Government were noted by Sir George Arthur, who brought to the subject a valuable fund of information which he had acquired during his previous administration in New South Wales, and thus early declared himself a decided patron and supporter of improvements in Indian wool. When visiting the Government sheep farms of Ahmednuggur and Amraut Mahub, he inspected the flocks and in a minute drawn up on the occasion remarked that "an improvement in the breed of sheep as regarded the views of Government was not an object that at all had reference to profit, but one on which the authorities took the lead, as being the best means of interesting industrious natives in the experiment." Sir George suggested the advantages which would be derived from establishing a more definite system in breeding in the first place by carefully ascertaining the defect on the indigenous race, and this done by steadily pursuing a good system of rejection and crossing. He at the same time adopted a fresh mode of pasturing and sub-division of the sheep in such a manner that no flock should exceed 700 head, and recommended that, in order to encourage the natives to try the experiment, a given number of the improved sheep should be transferred to the native shepherds under an agreement to provide pasture and attendance, receiving in payment one-third of the produce and so on.

Again about a year later, Sir George Arthur, having occasion to visit Allegoom, where the Government flock had been collected by a previous arrangement with the Superintendent, again inspected the stock, and in a minute written by himself, and dated 27th September 1843, he expressed himself much pleased with the manifest improvements in the condition of the sheep, which was such as showed the care and attention paid to them by the Superintendent,

1843.

EARLY EFFORTS TO IMPROVE THE BREED.

and the general appearance of the flock being greatly bettered by the removal of parti-colored sheep, recommending at the same time that no relaxation in this system should be allowed, and urging that it would be proper in the next report from the farm to have the sale price of the wool compared with the ordinary country sheep distinctly noted. Sir George Arthur observed that in order to ensure success, it would be necessary annually to import a fresh stock of merino rams till the improved stock had thoroughly superseded the country one on the farm.

1836. Captain Henderson, who acquired much information on the subject as a sheep-farmer at the Cape in 1836, submitted to the Government of Bombay a paper of instructions on the management of merino sheep. In this treatise the Captain states that on rearing these animals the diseases in India most to be guarded against are dysentery and mange. As a precaution against the first, he says that dry pasturage is most essential, and in order to prevent the mange, that great attention should be paid to the cleanliness of the sheep. A Patna ewe crossed with a Southdown ram was tried in Calcutta by a gentleman who had had considerable experience in the growth and cleaning of the staple in the Australian colonies, and he entered among the proceedings of the Agricultural and Horticultural Society of India the following results:—The wool is decidedly of a very good quality for the first cross. Uniting length of staple and softness with great uniformity of quality throughout the fleece which is much desirable. The quality from its coarseness will not admit of being used for other than blankets and very coarse cloth. Its market value was in the Home market 16*d.* per pound. He further states that Mr. Rickets, the wner, had acted correctly in having crossed Patna with the Southdown and should strongly recommend him to carry out the improvement by crossing the production with the merino, as he only requires now the texture, he having procured the length of staple with crosses. India can, in my opinion, if sufficient care were displayed in the crosses, produce as good a sample of wool as any of Her Majesty's dominions from the luxuriousness of feed and the temperature of the climate, as texture with length of staple is all that is necessary.

1837. Colonel Hazelwood, in writing to Captain Jacob, of the Bombay Artillery, dated Bangalpore, 1837, says:—I have just received six more Saxon rams from the ruby flock of Sydney. Mr. Sullivan brought out two merino rams and two ewes, and I have seen the effect of crossing by these and also by Southdown rams imported by Sir William Rumbold on the Neilgherries. Even the red hairy sheep of India become Southdown in size and wool in the second generation, and the white-woolled sheep of India become merino and Southdown in size and wool after one crossing. I have shown Mr. Sullivan's merinos which have been two years in India. After twice washing and shearing the day after the ewes gave five

or four and a half pounds each, in fineness, length of staple, elasticity and oiliness, equal to any I ever saw in Tasmania where 2½lb is the utmost ever got from a ewe of the merino kind.

EARLY EFFORTS TO IMPROVE INDIAN BREED.

Further Report by MR. ORRAH.

Since writing my report upon the wools of Bengal, I have received, by mail, a copy of the weekly paper of the 14th May 1887, called the "Wool and Textile Fabrics," which contains a report made by Mr. F. H. Bowman, D.S.C., F.R.S., an authority in England on technical matters upon Indian wools; I have therefore had a copy of the same written out, which I send to you with this letter:—

"We take the following paper on Colonial wools (by Mr. F. H. Bowman, D.S.C., F.R.S., &c., President of the Society of Dyers and Colourists) from the "Report on the Colonial sections of the Colonial and Indian Exhibition," issued under the supervision of the Council of the Society of Arts, and edited by the Secretary to the Society, H. Trueman Wood, Esq., M.A.

COLONIAL WOOL.

The whole of the wools exhibited from India, except one or two incidental specimens, were confined to those contained in a case within the Economic Court. In speaking of them as wools, the term is used in its widest sense so as to include all goat and sheep fibres. The samples were 23 in number, and no reference appears to be made to them specially in the official catalogue. Few of these samples were named specifically, the largest portion being only distinguished by a number or letter without label. In character they covered a wide range of quality from the very coarsest goat's hair down to the finest wool or pure pashmina, which is the undergrowth of the Thibetan shawl-goat, as well as the native Indian wools, of which there are at least eight varieties. These wools are interesting, as they contain almost every variation in the individual fibres which is to be found in all other races of sheep. Most of the hairs and wools exhibited in this section, however, are of comparatively small interest to European manufacturers, because the export is small and the quality such that they can only be used for the coarsest class of goods, and when worked by machinery they require to be mixed with other wools. They are, however, of considerable importance in India as forming the staple of the woollen industry in the mountain districts where the great bulk of the woollen goods are worn. Many of them are singular mixtures of coarse and fine fibres; so much so, that those who are only accustomed to the regular wools of cultivated sheep can hardly conceive it possible that many of the samples could be obtained from a single animal. The finest specimen in quality and regularity of fibre, and in all characteristics which are typical of the best wools, can scarcely be surpassed; but by far the largest numbers of samples are defaced by irregularities in the structure and quality of the fibre, which are only to be found in the most neglected sheep in the United Kingdom and the Colonies. To enumerate all the defects

COLONIAL WOOL.

which are found in many of these wools when compared with the highest standards attainable in the Australasian Colonies would be to mention all the defects to be found in any wool, and indeed many of the samples probably resemble the covering of the primitive sheep from which all the truly domesticated varieties are originally derived. Without further knowledge in regard to the place of origin, a mere classification of these wools would be of little service, and specially since the wools of India scarcely come within the scope of this report, and will probably receive attention elsewhere.

As already remarked, the wide range over which the growth of the wool extended, and the difference in climate and other conditions to which the sheep in the various colonies were subjected, rendered the present opportunity most valuable in making a comparative examination of the different wools. This survey brought home to the eye most forcibly the very wide range of conditions under which the sheep can be cultivated, and the high state of perfection to which it can attain in almost every part of the world, when due attention is paid to the culture and breed. It seems to indicate that special cases of sheep are more adapted to certain regions of the earth's surface than others, and that in many cases the environment of the sheep tends in the course of generations under careful management, to produce a special character which becomes permanent, and may be retained as a pure breed. It also shows that certain characteristics of the wool, such as lustre in the long-woolled breeds, can only be retained permanently by the re-introduction of fresh blood from time to time; at any rate, in all the regions which lie nearest to the equator, a certain degree of equality of temperature and atmospheric moisture being necessary for its permanence. Thus it appears to be retained longest in New Zealand and the southern coast of the Australian Continent. The nature of the herbage also affects the quality of the wool in a marked degree, and probably one of the chief reasons why the Australian merinos deteriorate when introduced into Cape Colony is because the herbage is not fitted for the highest development of the sheep. One very marked lesson of the Exhibition is the fact that all the best wools exhibited show that whatever tends to improve the character of the sheep in any one direction, re-acts all round in a benefit to all the other characteristics. The same conditions which tend to increase the size of the sheep cause the wool to be better nourished, firmer and more tenacious, without injury to the best qualities of the fibre, provided care is taken in the proper selection and purity of breed in the sheep. The question of difference in the lustre of the wool is an important one, and opens a wide field for investigation. It has been already noticed that the Victorian wools stand foremost in this respect amongst the merinos. When the fibres are examined by a microscope, it appears that while the fibres are equally fine when compared, say, with those from New South Wales, or South Australia, the development of

COLONIAL WOOL.

the individual scales on the surface is larger, and they present fewer scales in the linear inch. On the other hand, as the fineness in diameter is maintained in the less lustrous fibres, and the development of the scales is greater in number and this gives a greater softness and pliability to the individual fibres with a large degree of serration, and therefore a higher felting power. It is for this reason probably that the wools of New South Wales are more adapted for fine clothing trade than the more lustrous Victorian, or the coarser fibre wools of South Australia. The judicious introduction of the best characters of certain classes of sheep into other breeds, as is clearly shown, may induce a permanent improvement of the new breed only under certain conditions, and it seems now beyond a doubt that it will always be necessary for the farmer to discover the special class for which his own climate and surroundings are the most advantageous if he is to attain the highest perfection in the production of wool. Those who are growers of the wool must remember that every year the demand for quality in the raw material is greater, and those only who aim at securing all the best properties which wool can possess will secure the markets of the future.

In several instances 'kemps' were found associated with the wool. These kemps are fibres, usually shorter and thicker than the others, in which all traces of wool structure are absent. They are brittle, solid, and ivory like. This is the sure indication of want of trueness in breed, and is most objectionable, as these kempy fibres will neither felt nor take any dye. They cannot be removed from the fleece by any process, except picking them out, and hence they injure the quality of any goods for which the wool may be used. The defect was specially noticed in some of the cross-breds with the long-woolled sheep, and where it exists the value of the wool is most seriously deteriorated.

Nothing can compensate for the want of condition in the wool when sheep are neglected, and it cannot be too strongly urged that every endeavour should be made to maintain in the bulk the high standard presented in the samples exhibited. Without this care and due attention to classification, the results of good breeding and cultivation may all be lost, and rendered commercially unremunerative.

An endeavour was made in preparing this report by each specimen exhibited in relation to the geographical position in which it was grown to determine, if possible, whether any general law with regard to characteristic properties could be drawn from this relation, but the differences in the breed of sheep, and in the care and attention bestowed on the wool, rendered any sound deduction impossible, and it therefore appears probable the selection of breed, good pasturage and attention, have far more influence than mere geographical position within the range of the temperate zone."

REPORTS ON TIBET WOOL.

From S. E. J. CLARKE, Esq., Secretary, Bengal Chamber of Commerce, to M. FINUCANE, Esq., C.S.,—dated Calcutta, the 28th July 1887.

I have only received your letters of the 21st and 27th instant, the former handing me two samples of ram's wool and ewe's wool from Tibet, of which you wish to know the value in Calcutta. The samples have been exmained by the Committee of the Chamber of Commerce, who direct me to send you the enclosed copies of letters written by Messrs. Peel, Jacob and Company of this city, with reference to similar descriptions of wool sent to them from Darjeeling in the beginning of 1884. Such wool, say, 30 to 40 maunds, was then valued in Calcutta, at R18 per maund. It was, however, subsequently sold to the Elgin Mills Company of Cawnpore for R25 per maund.

Through the courtesy of Mr. J. L. Mackay, of Messrs. Mackinnon, Mackenzie and Company, I am able to supplement the information given by Messrs. Peel, Jacob and Company by a London Valuation Report, dated 18th May of the current year, on the same samples of Tibetan wool sent home by Mr. Mackay's firm. The valuation given is from 6¼*d.* to 7*d.* per pound at the then current market rates. The *Economist* gives the price January—June 1884, of unwashed wool at 7*d.* per pound. The value of wool similar to the samples you have now sent would be probably at that time 5*d.* to 5½*d.* per pound. The higher quotation given by Messrs. Buxton, Ronald and Company in May last is owing to the rise in the price of wool which has taken place during the last three years.

Tibetan wool is not well-known in this market, so that it is difficult to say what the demand for it would be.

The Committee of the Chamber of Commerce desire me to say that they are of opinion it would be advisable to send the samples* to the Elgin Mills Company at Cawnpore, and also to the Egerton Woollen Mills Company, Limited, at Dhariwal, Umritsur, from both of which concerns you would be likely to receive valuable and practical reports as to the quality of the wool and its suitability to their requirements. They would probably also be in a position to say what place it would take in the home market.

In conclusion, I am to say that, if you desire it, Mr. Mackay will be happy to send the samples home for valuation in London.* An early reply to this suggestion will oblige.

Report on Wool Samples referred to in Mr. Clarke's letter.

We have two samples of wool from you and value the first received at 5*d.* per pound, and that last received at 5½*d.* per pound. The wool is unwashed and unassorted; it is well grown and is of a sound and healthy character. Such wool would sell in Europe in any

* This has been done.——M. F.

† I have requested Mr. Clarke to have this done.

M. F.

REPORTS ON TIBET WOOL.

quantity. Of similar wool from Bombay, Kurrachee, and Beyrout, we sell 50 million pounds annually. There is always a market for such wool at a price; at present the value of all carpet wools (that is carpet wool) is remarkably low. Please refer to the figures in the enclosed circulars about East India wool, which will govern this wool also. Those figures are for washed wool, assorted into various colors and qualities; and it might be advisible to trace a small lot of the wool you have in view in this manner, and ship it to test this market. At the same time, we would certainly suggest that *five* or *ten* bales should be shipped in the natural state, and then we could report fully, and you would be prepared to act in the event of prices rising. It appears to us that the subject is one of great importance, for it is evident that the wool shown by your samples comes from a country *perfectly* adapted for the growth of a sound and healthy wool.

In Bombay and Kurrachee it is customary to assort and wash the wool before it is shipped, and this plan commends itself to our buyers. We send you samples of a parcel of Candahar wool which was worth 5¾*d.* per pound in its original state as clipped from the sheep, and we give you the result in the assorted and marked washed state of this wool. We do not, however, know what the wool weighed before it was washed:—

	lb.		lb.
No. 1.—	12,000	1st white value	11*d.*
„ 2.—	1,700	2nd „ „	7 ½
„ 3.—	6,000	Yellow „	9
„ 4.—	2,500	„ pieces „	6 ½
„ 5.—	1,200	Grey „	5 ½

From Messrs. Buxton, Ronald and Company, to Messrs. Duncan, Macneill and Company,—dated London, the 18th May 1887.

With reference to the sample of Tibet wool submitted to us this day for valuation, we beg to say we consider the wool worth from 6½ to 7*d.* per pound at present market values.

From Messrs. Peel, Jacob and Company, to the Secy. to the Bengal Chamber of Commerce,—dated Calcutta, the 14th January 1884.

The sample of wool referred to in your letter of 8th instant, is to hand, and we will endeavour to send you a valuation for it in a few days.

Our Liverpool correspondents, to whom we sent a sample of your wool, write us as follows:—

"We find the present value is about 5*d.* for unwashed, and, say, 9*d.* per pound if washed. It is recommended to be washed before shipment, and if in addition the colors be assorted, each sort being of course packed separately, higher prices would be obtained. We understand there is usually a good demand for this article."

REPORTS ON TIBET WOOL.

From Messrs. PEEL, JACOB AND COMPANY, to the Secy. to the Bengal Chamber of Commerce,—dated Calcutta, the 25th January 1884.

We much regret we have been unable to send you any report on the last sample of wool sent us, as we have not received any communication so far from the Elgin Mills, Cawnpore, to whom we sent it. We have now the pleasure to enclose a report on your earlier samples which we have received from our home correspondents, who have gone to some trouble in the matter, and we have sent you by post the five samples referred to therein. We enclose, for your further information, a Liverpool Wool Circular, details in which may be of interest to you. We would ask your careful consideration of the report, and would recommend you to make a trial shipment as suggested, with the view of commencing a regular business.

From the Agri-Horticultural Society of India, to the Director of Land Records and Agriculture, Bengal,—dated the 30th July 1887.

I am now in a position to reply to your demi-official No. 284 of the 21st instant, regarding two samples of wool from Tibet, ram and ewe. As mentioned in my previous note on this subject, there is very little trade done in wool in Calcutta, and the dealers in Tibetan wool amount to probably less than half a dozen in number. I have obtained the opinion of two of these traders on the samples. They consider they are good raw wools, but are very dirty, and their value would depend on the washing and cleaning they should receive before being put upon the market. In the present state, the wool would be unsaleable here. The final market for wool of good quality is Amritsar, and the price there for staple of the quality of the samples would be from ₹1 to ₹5 per seer according to the cleaning to which it has been subjected; it would there meet in competition Australian and European wools which are imported *viâ* Bombay. Another market would be found at the mills in the North-Western Provinces, but prices are not good there, as best qualities of wool are not sought after.

Of the two samples the ewe's wool is the better; the brown spots in it would, however, probably depreciate its value. From an European point of view the samples would be much improved were the two qualities of wool of which they are each composed separated. The outer wool of the sheep is wiry and harsh as compared to the soft inner fleece which is the more valuable. Should you desire it, I can obtain a more precise valuation from Bombay in a few days.

Letter from the Agent, Elgin Mills Company, to the Director of Land Records and Agriculture, Bengal,—dated Cawnpore, the 16th August 1887.

With reference to your No. 327, dated 3rd instant, and the sample packets of ewe and ram's wool from Tibet, I have the pleasure to give the following particulars.

Quality.—A very good combing wool, with about 33 per cent. natural grease. *Value.*—Can be purchased in the Cawnpore market at from ₹23 to ₹25 per maund.

We might perhaps be able to relieve you of a small quantity, but our consumption is only about 10,000lb.

Letter from the Manager, Egerton Woollen Mills Company, to the Director, Land Records and Agriculture, Bengal,—No. F.123 K., dated Dhariwal, Punjab, the 17th August 1887.

I have received two samples of wool you have been good enough to send me.

I had a standing order with Mr. Prestage all last year, to purchase 500 maunds of this wool at Darjeeling, but he entirely failed to procure for us some 50 maunds. This year I made a contract with another gentleman, and he, with the greatest difficulty, has succeeded in getting me 250 maunds. I cannot say yet to what extent I should be likely to take this wool, as we get identically the same from Tibet through our part of the Himalayas, but it is certain that no single part of Tibet could possibly produce 10,000 maunds in a year, as that means the fleeces of over 200,000 sheep.

We gave ₹20 a maund for our each consignment delivered at Sealdah.

From the Agri-Horticultural Society of India to the Government of India,—dated Calcutta, the 3rd January 1887.

I have the honour to acknowledge your No. 262—7-23 F. & S., dated the 19th ultimo, which I had the honour of placing before a General Meeting of the Society, and I am directed in reply to send you copy of a demi-official letter from Babu Protapa Chundra Ghosha reporting on the samples of wool which accompanied your letter.

Letter from Babu P. C. GHOSHA, dated the 30th December 1887.

I have examined the six samples of Thibet wool sent by you, and I have got a Kashmeri shawl merchant to examine and value the same. He declares sample No. 5 to be the best of the batch. Of Black wool, the sample No. 3, though good in its way, is not so far superior to No. 6 as to justify the difference of ₹3 in the maund. Just as I stated in my previous letter, a great deal depends upon the kind of carding and cleaning each sample received before it is brought down to India for sale. As an extensive manufacturer of hawl and woollen goods both at Amritsar and Kashmir, he is of opinion that in purchasing large quantities, the quality actually supplied is much inferior to the samples, and the difference of the quality of the sample, and that of the goods in bales varies indirectly as the quantity of the sample, and directly as that of the

REPORTS ON TIBET WOOL.

goods purchased. The smaller the quantity of sample, the better it becomes by handling. There, however, cannot be any question as to the quality of Tibet wool generally. They are superior in fineness and length of staple to any foreign wool brought to India. But one must not forget that the value of the wool, provided it be fine in texture, is regulated wholly and entirely by the degree of its cleanliness. Tibet wool is the only superior wool which is used by the shawl-makers, both in and out of India. As I said before, Rampur and Yarkand are the two principal marts. But the supply is so uncertain and precarious and the prices so varying, that it is quite difficult to form any idea on its export value. The wool-dealers of the frontiers are of opinion that India is a better market for such wool than any other country, and I think we ought to endorse the same.

From the notes on the samples sent it will be found that a very limited supply of the six different samples is available—

	Maunds.		Maunds.
I	100	IV	2,000
II	100	V	25
III	100	VI	200
			2,525

The total available supply of all sorts being about 2,500 maunds. Of this total, about 2,000 maunds are consumed annually by the people of India in the way of blankets and coarse cloth manufactured in Sikkim, South Bhutan, Garhwal, Nepal, Rampur, and other hill places. The remainder, the better and finer quality, are all taken up by the shawl manufacturers. The prices paid by them for wool of average quality I have already quoted in my previous note on wool. It would therefore be much desirable to so far facilitate the import of that article to India as would make the material available to all classes of wool manufacturers of the country for home consumption. Assam, Cachar, and the ten districts are the great places for woollen blankets which come from Tibet through Sikkim.

As for the value of the samples in Calcutta market, I regret to have to report that there are no native purchasers for the same. I do not know whether the European manufacturers would care to get their wool from Tibet when they can get perhaps at less cost almost as good material from America, Australia, and Germany.

From the Secretary, Bengal Chamber of Commerce, to the Government of India,—No. 218-88, dated Calcutta, the 9th March 1888.

The Committee of the Chamber of Commerce direct me to acknowledge your Office No. 261—7-23 of 19th December, forwarding for valuation six samples of Tibetan wool received by your office from the Director of Land Records and Agriculture,

North-Western Provinces and Oudh, and calling for any remarks the Chamber may have to make on the subject of a wool trade with Tibet.

In reply to the communication under acknowledgment, I am to say that the Committee can add nothing to what was said in my letter of 18th November last. So long as the Tibetans are allowed to occupy a position within the Sikkim border from which they can at will block the Jeylap-la-pass, the trade must necessarily depend upon their good will. This matter is, however, before the Government of India.

On the general subject of improving the wool trade of Bengal the Committee will be glad to receive any further communications from you showing how the suggestions of Mr. Abbott and Mr. Orrah have been dealt with.

I now come to the valuation of the six samples of wool sent with your letter under reply, and returned herewith. For the London prices now given, the Committee are indebted to the courtesy of Messrs. Mackinnon, Mackenzie & Co.—

Sample No. 1.—Price per maund at Josimatti ₹20 the seer, weighing 80 tolas; about 100 maunds can be purchased.

London report, No. 1.—Grey, good quality (if greasy); probable value 5¼*d.* per pound.

No. II.—White wool, supply available 100 maunds, the seer weighing 80 tolas; price at Josimatti ₹20.

London report, No. 2.—Cashmere, coarse white, 8¾*d.* per pound.

No. III.—Black wool, available supply 100 maunds. Local price ₹25 per maund.

London report, No. 3.—Black, good quality (if washed), 7½*d.* per pound.

No. IV.—White wool, available, supply 2,000 maunds. Local price ₹20 per maund.

London report, No. 4.—White, good quality (if washed), 6½*d.* to 7*d.* per pound.

No. V.—Good white wool, available supply 25 maunds. Local price ₹40 per maund.

London report.—Cashmere, white fine, 10½*d.* per pound.

No. VI.—Black wool; available supply 200 maunds. Local price ₹22 per maund.

London report, No. 6.—Dark grey (if washed), 6½*d.* to 7*d.* per pound. The report goes on to say—"Our brokers say it is difficult to value on such small samples, but they assume the bulk to be fairly represented and *not loaded with sand*. This should be guarded against, as we are told the natives put any rubbish up with their wool."

NOTE.—Arrangements are now being made to supply Mr. H. E. Abbott, through the Director, Department of Land Records and Agriculture, Bengal, with a few merino ewes from the Doonagiri Estate in Kumaon. Mr. Abbott has already been supplied with two merino rams.

APPENDIX.

Price of wool in England, per stone of 24lb since 1818.

Year.	Laid Cheviot.	White Cheviot.	Laid Highland.	White Highland.
	s. d. s. d.	s. d. s. d.	s. d. s. d.	s. d. s. d.
1818	40 0 to 42 2	...	20 0 to 22 6	...
1819	21 0 „ 22 0	...	10 0 „ 10 3	...
1820	20 0 „ 22 0	...	9 0 „ 10 0	...
1821	18 0 „ 20 0	...	9 0 „ 10 0	...
1822	12 6 „ 14 6	...	5 0 „ 6 3	...
1823	9 0 „ 10 6	...	5 0 „ 5 9	...
1824	13 6 „ 15 0	...	6 0 „ 6 3	...
1825	10 6 „ 22 0	...	10 0 „ 10 6	...
1826	11 0 „ 14 0	...	5 0 „ 5 6	...
1827	11 0 „ 14 0	...	5 6 „ 6 9	...
1828	8 0 „ 11 0	...	5 6 „ 6 0	...
1829	8 6 „ 11 0	...	4 3 ...	...
1830	9 6 „ 11 0	...	4 6 to 5 0	...
1831	17 0 „ 20 0	...	7 6 „ 8 6	...
1832	14 0 „ 16 0	...	7 0 „ 7 6	...
1833	18 0 „ 20 7	...	10 0 „ 11 0	...
1834	21 0 „ 24 6	...	5 6 „ 7 0	...
1835	19 0 „ 20 6	...	9 6 „ 10 8	...
1836	21 0 „ 25 0	...	10 0 „ 14 0	...
1837	12 0 „ 14 0	...	7 0 „ 7 8	...
1838	19 0 „ 22 6	...	6 0 „ 10 0	...
1839	18 0 „ 20 0	...	8 0 „ 12 0	...
1840	...	...	7 0 ...	...
1841	15 0 to 16 9	...	6 0 to 7 5	...
1842	12 6 „ 14 0	...	not quoted.	...
1843	9 0 „ 11 6	...	5 0 to 6 0	...
1844	15 0 „ 18 0	...	not quoted.	...
1845	14 6 „ 17 6	...	7 6 to 8 6	...
1846	12 0 „ 14 6	...	8 0 „ 8 6	...
1847	12 6 „ 14 0	...	not quoted.	...
1848	9 6 „ 11 0	...	4 9 ...	...
1849	12 0 „ 16 6	...	6 0 to 6 3	...
1850	15 0 „ 17 6	...	8 0 „ 8 6	...
1851	12 0 „ 16 0	...	8 0 „ 9 3	...
1852	13 0 „ 15 0	...	8 0 „ 9 0	...
1853	19 0 „ 22 0	...	11 0 „ 12 6	...
1854	12 0 „ 15 0	...	7 6 „ 8 6	...
1855	14 6 „ 19 0	...	8 6 „ 9 0	...
1856	19 0 „ 21 6	...	11 0 ...	...
1857	19 0 „ 24 0	...	13 0 to 14 3	...
1858	15 0 „ 17 0	...	8 9 „ 10 0	...
1859	18 6 „ 24 0	...	10 9 „ 11 6	...
1860	22 0 „ 32 0	37 0 to 38 0	10 0 „ 11 3	...
1861	19 6 „ 27 0	from 30s. upwards	not quoted.	...
1862	18 6 „ 26 0	30 0 to 37 0	11 6 to 16 0	...
1863	25 6 „ 31 0	38 0 „ 42 0	15 3 „ 17 6	...
1864	31 0 „ 39 0	47 0 „ 54 0	17 6 „ 20 0	...
1865	23 0 „ 30 0	44 0 „ 45 0	15 0 „ 17 0	...
1866	24 0 „ 36 0	30 0 „ 38 0	14 0 „ 16 0	...
1867	16 0 „ 21 6	not quoted.	not quoted,	...
1868	19 0 „ 26 0	28 0 to 32 0	8 6 to 9 0	...
1869	18 0 „ 26 6	not quoted.	8 6 „ 10 0	...
1870	15 0 „ 23 6	25 0 to 26 0	9 6 ...	...
1871	20 0 „ 26 6	30 0 „ 34 6	12 0 to 15 0	...
1872	26 0 „ 37 6	40 0 „ 48 0	18 0 „ 21 0	...
1873	17 0 „ 18 0	34 0 „ 40 0	9 0 „ 12 0	...
1874	18 6 „ 26 6	30 0 „ 34 0	9 6 „ 13 0	...
1875	25 0 „ 32 0	34 6 „ 36 0	12 6 „ 16 0	...
1876	20 0 „ 24 0	30 0 „ 34 6	9 6 „ 12 0	...
1877	20 9 „ 26 0	28 0 „ 30 0	10 0 „ 12 0	...
1878	18 9 „ 25 0	27 0 „ 32 0	8 6 „ 11 6	...
1879	15 0 „ 17 0	Prices very low.	7 0 ...	...
1880	20 0 „ 24 0	30 0 to 32 0	10 6 to 11 6	14 0 to 15 0
1881	17 0 „ 21 0	27 0 „ 30 0	5 0 „ 9 6	12 0 „ 13 0
1882	14 0 „ 18 0	27 6 „ 28 0	7 6 „ 9 6	13 0 „ 14 0
1883	13 0 „ 18 0	26 0 „ 28 0	6 6 „ 8 6	11 6 „ 12 6
1884	13 0 „ 18 0	26 0 „ 28 0	6 6 „ 8 6	11 6 „ 12 6
1885	12 0 „ 17 0	22 6 „ 26 0	6 0 „ 8 0	11 6 „ 12 0
1886	13 0 „ 18 0	23 0 „ 27 6	6 6 „ 8 6	11 6 „ 12 0
1887	14 0 „ 22 0	23 0 „ 28 0	7 0 „ 9 0	11 6 „ 13 0

VOL. I.; PART I. (No. 4); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

Note on a Red and a Yellow Dye said to have been prepared in Bombay during 1787, the knowledge of which appears to have died out within the present century.

Early Exploration of Western India.

In the Selections from the Records of the Government of Bombay, was published, in 1855, the journal of an exploration of certain parts of the Bombay Presidency made by a Polish gentleman of whom remarkably little has been heard during the past hundred years. His collections and the manuscripts of his journal were deposited in the British Museum; and at the suggestion of **Robert Brown**, the late **Dr. Gibson** of Bombay edited the publication of the journal—the sole record of the labours of one of the earliest scientific explorers of Western India. From what the writer can learn, **Hove's** collections were never critically examined; and the result has been that while **Dr. Gibson**, from his intimate knowledge of the Bombay flora, was able to annotate the journal, a large proportion of the plants collected, and the economic facts recorded regarding these, have been lost to the world. It would seem desirable that some effort should be made to discover if **Dr. Hove's** collections are still in existence, or exist in such a condition that even after the lapse of a hundred years some honour could be done to the memory of an indefatigable explorer, of whom **Dr. Gibson** very appropriately wrote: "Neither miry roads, heavy rains, nor a country infested by bands of mounted robbers, seemed to have had terrors for him."

Dr. Hove appears to have been sent to India by the English Ministry of the day to examine and report on the cotton trade of India. So jealously, however, did the officials of the East India Company look on his exploration that every obstacle was put in his way; and, apparently, the oblivion into which he fell, even in Europe, had some connection with the Company's treatment of him. It seems probable that remonstrances against his mission may have conduced towards the silence with which his return to London was received. It is just possible, however, that he may have been sent to India by some private speculator or company and had no connection whatever with the English Government. Be that as it may, **Dr. Hove's** labours and the discoveries he made richly entitle him to a foremost place among Indian explorers.

He gives the fullest and most detailed account of the cultivation and

manufacture of cotton; but being a careful and painstaking observer, he lost no opportunity of recording whatever he came in contact with. He deals fully with the indigo industry of Western India—an industry that has practically disappeared; he treats of wheat, of wool, and of carnelian; and records the fact that the practice of transplanting rice had only just been introduced into Western India; that in one of the districts he visited sugar-cane was a new crop which the cultivators did not fully understand; and in connection with cotton, he describes a process of cultivation and irrigation which has been entirely discontinued. From his descriptions of the cotton under cultivation, one is forced to the conclusion that American cotton was only grown as a curiosity, and that, in addition to **Gossypium herbaceum**, the so-called arborescent cotton, **G. arboreum**, was a regular and valued crop. This is certainly not the case at the present day; and the cultivation of that species has been abandoned, to some extent at least, in consequence of the introduction of, and hybridisation with, American cotton. In several places also he alludes to Nankeen cotton as a dyed textile imported into India from China, the dye for which was exported from India to China. His diary was, apparently, never revised by himself, and hence the occasional contradictions that occur. Thus, for example, he was shown a sample of Indian-grown Nankeen cotton, and was assured the fibre grew in that colour. That Nankeen or *kaki* cotton is naturally coloured need not be further dwelt on. We have, in Hove's journal, two, or perhaps only one, dye-stuff which was manufactured from one if not two plants grown in Bombay for the Chinese market—a dye which the people of India assumed was used by the Chinese for colouring Nankeen cotton. This trade has not only long since disappeared, but apparently so also has the art of preparing the dye or dyes alluded to. **Dr. Hove** may be allowed to speak for himself—the remark only being premised that his English is that of a foreigner one hundred years ago. At pages 19 and 20 he observes:—

Yellow Dye exported to China.

"This morning I set out once more for the Continent" (mainland opposite Tanna) "to observe some plantations of trees the fruit of which is exported for the China market and used for a yellow dye. In the evening I came to Panging village. . . . The trees are planted in straight lines about 30 feet from each other. They grow to the size and thickness of an apple tree; and by the account I had from the planter, they flowered in the month of June, and were now (September) full of oblong drupaceous fruits. The planter gave me some seeds from the last crop, and told me that two of them would serve for a purge. However, by experience one of them is sufficient to answer the purpose. They sell it here at R2 per mohn (maund); the mohn contains 50 seers or 48 English weight. I could not observe that they bestow any particular treatment after they are planted, except that they water them during the hot season from reservoirs which are hollowed at the foot of the mountain, and contain a considerable quantity of water. The planter told me that he plants the seeds at the depth of six inches about a month before the rains have set in, and that the fruit ripens in December and January. The soil throughout the plantation consisted of a heavy clay."

Dr. Gibson has the following remark on the above passage in paragraph 14 of the Preface:—

"On one point I must confess my ignorance, *viz.*, as to the shrub which is alluded to. I mean a tree which he (**Dr. Hove**) speaks of as cultivated on the mainland opposite to Tanna, having an oblong drupaceous fruit of a purgative character and exported to China for a yellow dye. I would suppose him to have alluded to the *Heerda* or **Terminalia Chebula**, but for the circumstance which he mentions as to the tree being planted in June and producing fruit in November. Perhaps some of the herbaceous Crotons might suit the description, which can hardly apply

to the *Woondy* or **Calysaccion**, a shrub still grown though not cultivated in that quarter."

In a further passage, pages 61 and 62, Dr. Hove alludes to another dye sent from India to China?; but there can be no doubt as to the plant from which this was obtained. He gives the scientific name for it—**Bixa Orellana**—and his descriptions show unmistakeably that his determination was correct. He remarks on the 9th December 1787 :—

Red and Yellow Dye.

"I set out to Morga or Botodra garden, about 6 miles from Dowlat, where my people told me were several exotic trees and flowers. The garden is remarkably large and is pleasantly situated on the banks of the Sabermatty, interspersed with channels, tanks, and bathing places. . . . Next to the garden I met a small plantation of **Bixa** trees which they cultivate for a red and a yellow dye. They were just in blossom, which is white, and so plentiful that the shrubs which grow from 15 to 20 feet appeared at a distance like new white-washed pillows. . . . The pericarpium consists of an echinate, divalvular, elastic capsula, and numerous oblong pointed seeds which are incrusted with a reddish substance which they chiefly use in dyeing their scarlet turbans. The roots and leaves of this plant produce likewise a yellow dye, which, when combined with that of the seeds, become near the Nankeen colour of China; and the colour is lasting. As they export this dye to China with great advantage, it leads me to suppose that the Chinese dye their Nankeen with the extract of this shrub. They are planted in straight lines about 10 feet from each other, and were watered from a well that was situated in rising ground in the midst of every plantation. The soil of this district consists of a yellowish clay. I understand that at Humali village, about 20 miles from Brodra (Botodra?) large plantations are laid out with nothing else but these shrubs. The seeds are sown for a new plantation in a separate ground from whence the shrubs are afterwards transplanted into the plantation in the beginning of the rains."

Dye from Roots and Leaves of Bixa.

That **Bixa Orellana** was a cultivated plant in India 100 years ago is itself an important fact; but when we add to this that a yellow dye was extracted from the roots and leaves, which, when mixed with the red dye from the seeds, produced a permanent colour, the inference is unavoidable that either **Dr. Hove** was misinformed, or that we have lost an interesting and important industry within the past century. At pages 117 and 118, **Hove** again returns to the subject of **Bixa**—

Permanent Colour.

"I made another excursion to Botodra garden and found the seeds of the red dye (**Bixa Orellana**) in full perfection; but the overseer would not part with a grain until I had an order from the Rajah. The leaves of all these shrubs had been stripped three weeks ago, and began to sprout out again very luxuriantly. By the account I had from the overseers they are gathered four times a year—the first about the beginning of September, and the rest successively every three months during the season. *The art of extracting the dye, he told me, was done in the same manner as with indigo.* The dye of the seeds is taken off by rain water in which it is suffered to soak for two months, to which they add a certain quantity of gum arabic and combine it with the yellowish dye of the extract of the roots and leaves. After it is formed into small cakes they export it to China and the neighbouring markets.* The price of it is per candy, that is 22 maunds, R2,700, and if sold or bought in a smaller quantity, the price is considerably higher. I understand that the plantations yield 16 candies a year; but of late the quality is far inferior to what it has been, occasioned by the demand that there is for it, of which they take advantage, and adulterate it with different ingredients, but especially the yellow drupaceous seeds that are cultivated in the Mahratta country and a kind of flower which they call *Kissury*"—(the farinaceous covering of the fruits of **Mallotus philippinensis**)—"which is imported from the Rajpeepla country."

Indigo in Bombay.

Here we are informed that the dye from the leaves was extracted after the same manner as followed in the preparation of indigo. It can hardly be said that the **Bixa** is anywhere cultivated as a commercial product at the present day in India. Its cultivation has been discontinued in Bombay, and it seems probable that the decline of this industry may have been brought about by the same causes that operated injuriously against the Bombay indigo trade. No dye-stuff is now prepared on a commercial scale in Western India, and it seems just possible that a fact of considerable interest in the economic history of **Bixa Orellana** was thereby lost to the world.

Bixa Dye from the leaves and roots.

The writer is not aware of the knowledge of the dye from the leaves and roots being possessed by the inhabitants of any other part of the world. The subject is one which admits of the readiest solution. **Bixa Orellana** is a weed growing in the hedgerows of India in every province. A quantity of the leaves might easily be macerated, and the dye alluded to extracted. Similarly, the roots might be treated much after the fashion of the extraction of *Al* dye. If these yield a yellow dye so far **Dr. Hove's** statements would be confirmed, but it would be a comparatively simple matter to carry the enquiry one step further and to ascertain if a mixture of the colour from the seeds with that from the roots and leaves, produces, as **Dr. Hove** says, a "lasting" dye. The writer may add that an Indigo-planter recently informed him that he was experimenting on a large scale with the leaves of **Lawsonia alba** in the preparation of a reddish dye which he isolates in the same manner as in the preparation of indigo. May it not be that the suggestion to do so arose from a native tradition in some way connected with the facts discovered by **Dr. Hove** regarding **Bixa**?

A permanent Bixa Dye.

Red Dye from the leaves of Lawsonia.

It may be here pointed out that the refusal to supply **Dr. Hove** with seeds would indicate that the plant existed only under cultivation instead of being, as at the present day, a roadside weed of village situations. **Dr. Roxburgh** arrived at the conclusion that the white-flowered form of **Bixa**, with green capsules, was indigenous to India. This was afterwards named **Bixa indica** in **Voigt's** *Hortus Suburbanus Calcuttensis*. But **Dr. Buchanan Hamilton**, in his *Statistics of Dinajpur* (1833), states that **Bixa** is an American plant. In this opinion all modern writers concur; but he adds that the natives "have called it *Lotkan*, and they say that before it grew commonly in the country, the dry fruit was brought from Patna. Probably some other fruit was then brought, and its use has been superseded by that of **Bixa**, to which the natives have given the old name." It seems highly probable that the Patna supply, indeed, the Indian supply generally during the 18th century, was drawn from the Bombay plantations. (Conf. with *Dictionary, Economic Products of India*, **C. 2229.**)

Like **Dr. Gibson** the writer has puzzled over the dye described in the first of the passages given above. There seems little doubt that it was perfectly distinct from **Bixa** cultivation, although it may have yielded a similar dye-stuff since it went to the same market. The description of the tree with the drupaceous fruit and purgative seed will agree neither with **Bixa** nor with any dye-yielding plant with which the writer is familiar; unless we attribute it to **Terminalia Chebula**, and thus read the remarks as to season of planting as not necessarily implying an annual. The dye prepared from the plant was, like that of **Bixa**, exported to China; and **Dr. Hove**, perhaps from a native suggestion, believed that these dyes were employed to produce the colour of the Nankeen cotton. It has, however, been shown that **Dr. Hove's** faith in this rumour was seriously shaken by the discovery of Nankeen cotton in India. After all, the use to which the Chinese put these dyes is a secondary consideration to the fact that two plants were, in 1787, cultivated in Bombay to produce dyes which were then in demand by the Chinese. **Dr. Hove** alludes to the fact that the trade, even in his day, had begun to decline owing to the natives taking to adulteration. He mentions the fact that *Kamela* dye (the powder from the fruits of

Mallotus philippinensis) was used as an adulterant. This allusion removes any suspicion that *Kamela* could have been either of the two cultivated plants. The adulterant may, however, ultimately have come to take the place of the original dye, since *Kamela* to this day is exported from India. But the writer has some suspicion there may have been a mistake, that the people may have even grown **Bixa** as an adulterant for some other dye, possibly the *Al*—**Morinda citrifolia** and **M. tinctoria**,—and that they may have shown **Bixa** to deceive the inquisitive European. The possible extraction of a dye from the leaves and roots of **Bixa** would dispel all such surmises. The subject seems well worthy of investigation; and as many persons having a mind to try such experiments may not have access to Dr. Hove's Journal, the writer has thrown together these passages, with his own comments on them, in the hope that they may prove useful.

Dyes of Bombay in 1596.

In conclusion it may be added that two hundred years before the date of Hove's visit to India the indefatigable traveller **John Huyghen van Linschoten** wrote an account of what he saw personally and learned from others regarding the Western Coast territories of India. While he carefully describes all the chief products—animal, vegetable, and mineral—he is singularly silent on certain things, and of dyes he briefly alludes to only Indigo, Sappan wood, and **Nyctanthes arbor-tristis**. The city of Bombay had practically no existence then (1596), but **Linschoten** appears to have wandered over the site where it now stands; he visited the great caves, and was indeed the first to give an account of these wonderful results of man's art and skill. To him also are we indebted for the discovery of Opium, he having been the first European to examine and describe that drug. Indian-hemp (*bhang* and *ganja*), Mangoes, Cardamoms, Pepper, Betel, and a hundred other characteristic products of Western India are all carefully described by **Linschoten**. Even Myrobalans come in for a share of his attention, though his account of them appears mainly derived from the works of his contemporary **Garcia de Orta**. He describes five forms in the following passage:—"The myrabolams are found in many places of India, that is, in Cambaia, in the land of Ballagate, in Goa, in Malabar, and in Bengalen; whereof there are five sortes? The first by Physitians called Citrinos and by Indians *arare*, those are round and are used to purge Choller. The second, which are called Emblicos, and in India *amuale*, are used in India to tanne Leather withal, as Tanners use Sumach, and when they are ripe and also green, they eate them for an appetite. The third sort in India called *Resonualle* by the Physitians Indians, are eight-cornered. The fourth by the Physitians called Belleicos and by the Indians *gutij*, are also round. The first and the last are in India called *aretean*, and by the Physitians *Quebulus*, those are somewhat long, roundish with points."

Indigo.
Sappan-wood.

Nyctanthes.

Myrobalans.

Now the first myrobalan described above seems to be **Terminalia Chebula**, an abundant tree in Western India and closely allied to **T. citrina**, *Roxb.*, a native of Eastern Bengal, Assam, Burma, and the Andaman Islands. Even modern botanists, however, are not over-certain as to the specific distinctions of these two plants, so that it is pretty certain they were both designated *Citrinos* by the early writers. Although the Chebulic Myrobalan is not known at the present day to be employed by itself to any extent as a dye material, it is largely used as an adjunct in dyeing; but what colouring property it possesses is certainly yellow. Medicinally it is a laxative. Hindu writers extol the merits of several forms of this medicinal fruit, and it would seem that the spirit of this appreciation of its virtues fully permeated the minds of European physicians in Linschoten's time, and had not been quite eradicated even when Hove visited India. There would thus appear little room for doubting that Hove's drupaceous, purgative, and dye-yielding fruit was the Chebulic myrobalan. As a tanning material it imparts to the leather a bright

yellow colour, and in certain combinations it produces some of the most permanent dyes which we possess; but it is nowhere now grown in special plantations, nor is a dye material prepared from it in the manner indicated by Hove. Within recent years the Forest Department (especially in Bombay) has given careful attention to the subject of the Chebulic Myrobalan. The reader is referred for further particulars regarding it to another number of these Selections, where the writer, in an official note furnished to the Revenue and Agricultural Department, has endeavoured to bring together recent discoveries regarding some of the more important tanning materials of India.

GEORGE WATT,

Simla, January 1888. *Reporter on Economic Products.*

Vol. I.; Part I. (No. 5); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

A Tea Substitute used in the Himalayan Regions.

Office Memo. from DR. GEORGE WATT, C.I.E., Reporter on Economic Products, to the Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—No. 51—122-2S., dated Simla, the 23rd December 1887.

With reference to your Office Memorandum No. 1010—145-2A. of the 16th instant, the undersigned has the honour to reply that the supposed discovery of a new tea, therein alluded to, is a very old story. It was first pointed out by **Mr. Moorcroft** in 1821, that the natives of Basáhr used the leaves of a species of **Osyris** as a substitute for tea. Later on, **Bishop Heber**, in his visit to Almora, fell into the mistake which the native gentleman alluded to in Mr. Lawrence's Memorandum has done, *viz.*, of viewing the plant as tea. The leaves of **Osyris arborea** (the plant forwarded along with the Memorandum) are used, here and there, throughout the Himálayas from Almora to Sikkim, in place of tea. As in the case of the sample forwarded for inspection, they smell remarkably like tea when specially prepared; but unfortunately the infusion has powerful emetic properties which require long usage to conquer. **Dr. Royle** suggested that experiments should be made in the cultivation of the plant in order to discover if this emetic property could be removed by careful cultivation. The discovery of tea proper in Assam, and the greatly extended cultivation of that plant, have left the matter of **Osyris** tea in the position in which it was at the beginning of the present century, when it first attracted the attention of the public.

The plant is very common around Simla; it is known as *Bakardharra*, *bakarja*, in Kumáon; *Popli* in Belgaum, and *Jhuri* in Nepál, &c. It is closely allied to the sandal-wood, but it seems to possess no properties that would justify its cultivation, since tea can be produced quite as cheap. I would suggest that one of the samples of this tea-substitute, herewith returned, be sent to Kew, since, as a Museum sample, it may be interesting to the Director; and that the other go to the Economic Museum, Calcutta, together with a copy of this letter.

Vol. I; Part I (No. 6); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

Cobaltiferous Matt or Cheep from Nepal.

From C. E. R. GIRDLESTONE, Esq., Resident, Nepal, to SIR E. C. BUCK,—dated 30th January 1888.

Would you mind reading the enclosed and then examining the "cheep" which is in the accompanying packet. I should be glad to know what it is, and what may be its commercial value.

From DUNCAN RICKETTS, Esq., to C. E. R. GIRDLESTONE, Esq.,—dated Doolha, Gorakhpur District, 23rd January 1888.

You asked me to send you some of the stuff that is brought in from Nepál called "cheep." I have the pleasure to send you a parcel containing the metal. I would have sent it before, but none was procurable in the market till now—I suppose owing to the disturbed state of the country it was not brought down.

The people who bring it, tell me that there are several smelting mines of the stuff, and that it is only obtained close by the copper mines in Nepál. The name of the locality is "Kachipatar," Argah Zillah, Sowrobhar, about 80 miles north of Doolha. The price on the spot is R30 to R35 per maund, and they sell it here at from R40 to R50 per maund.

* * * * * * *

From WILLIAM KING, Esq., D.Sc., Director, Geological Survey of India, to the Under Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—No. 79, dated Calcutta, 14th February 1888.

With reference to your letter No. 21—11-3M. of the 8th February 1888, I have the honour to inform you that the specimens of metal from Nepál called "Cheep" are Cobaltiferous Matt, exactly similar to another specimen already in the Geological Museum, and which was found by Mr. Mallet to contain 11 per cent. of cobalt.

This specimen in the Museum was sent in from Nepál, but without any information as to locality; and it was surmised that the artificial product was obtained near copper mines. The information appended to your letter now brings the matter of locality closer.

I may mention that the metal is probably used for the colouring of glass and enamels.

From W. C. MACPHERSON, Esq., Officiating Under-Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT, to C. E. R. GIRDLESTONE, Esq.,—No. 51M., dated Calcutta, 10th March 1888.

In continuation of Sir E. C. Buck's demi-official letter No. 18 of the 6th ultimo, I am directed to send you a copy of a letter from the Director, Geological Survey, regarding the specimens of Cobaltiferous Matt, known in Nepál as "Cheep." I am also desired to send you by parcel post two of the specimens, together with six spare copies of the correspondence on the subject, as you may wish to have the samples valued at home.

NOTE.—We have asked the Resident to try and get half a maund of the substance.

[For further information the reader is referred to the brief account of Cobalt given in the *Dictionary of Economic Products*, C. 1444.—*Ed.*]

Vol. I.; Part I. (No. 7); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

Supposed Discovery of Petroleum in Alwar.

From W. KING, Esq., D.Sc., Director, Geological Survey of India, to the Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—No. 24, dated Calcutta, the 14th January 1888.

In continuation of my letter No. 503 of 22nd November last, and in further reply to your No. 115—22-2M. of the 21st November, enquiring as to the probability of finding petroleum in Alwar, I now have the honour to send in Mr. R. D. Oldham's report on his examination of the locality.

Mr. Oldham writes:—

"I found the 'Bitumen' mentioned in the Manual of the Geology of India to be well known to the people of the neighbourhood.

"On visiting the spot I found it to be situated on a small sandy knoll not far from the town where the stuff occurs in the manner described by Dr. Ffrench Mullen. It is not abundant, but I was able to collect a few pounds weight of lumps of sand impregnated with some dark-coloured hydrocarbon in a short while. On examination these proved to be for the most part brown in colour, a few locally black, but even then the streak was brown. The freshly-fractured surface had a faint tarry smell and shewed a cavernous structure.

"I examined some samples roughly. On heating before a blow-pipe they give off a dense pungent smoke, reminding one of the smell of incense; no fragment procured by me would burn by itself, but if heated sufficiently it would catch fire and blaze for a short while until the volatile matter had been driven off. Heated in a matrix dense fumes were given off, from which some small quantity of water was deposited, and afterwards an oily liquid, which, near the base of the tube, was dark brown in colour and solidified on cooling, while higher up the liquid was amber-coloured and did not solidify; both were some form of hydrocarbon.

"As regards its mode of occurrence, I find it is confined in locality to the site of an ancient village, as described in the Manual; and an excavation I had made yielded some fragments in the upper layer consisting of gravel, potsherds, charcoal, &c., the débris of the old village; but none whatever from the underlying undisturbed sand. The excavation was carried down 6 feet, but no trace of bitumen nor of any odour of petroleum was detectable. I have no doubt that, whether the explanation proposed in the Manual be the correct one or not, the substance is purely of superfi-

cial origin. Nothing would therefore be gained by making a deep boring, and the amount procurable is insignificant even were the stuff of any value.

"The country generally is an open sandy plain in which isolated hills of barren quartzite rise. There is little chance of workable bitumen or petroleum being found in the neighbourhood."

The substance sent down by Mr. Oldham has been thoroughly examined in the laboratory by Mr. E. J. Jones, who reports as follows:—

"The bituminous earth from Tijarah, Alwar, consists of a fine laminated friable sandy clay containing layers which are impregnated with organic matter in very variable proportion. The earth also contains potsherds even in the layers containing the organic matter.

"This organic matter imparts a dark brown colour to the clay (itself of a pale brown colour), while the fractured surface has a slightly vitreous lustre. It is inodorous. A fragment of the portion impregnated with the organic matter takes fire in the flame of a Bunsen burner and continues to burn for a short time after removal from the flame, but can be readily re-ignited. While burning, a smell faintly resembling incense is given off.

"The substance resembles very closely the specimens preserved in the Museum which were sent by Dr. Ffrench Mullen in 1874, and which were found to contain 30—60 per cent. organic matter.

"The substance can be readily reduced to powder from which water extracts a small quantity of light brown organic matter. Alcohol extracts a considerable quantity of a greenish brown substance which hardens when the alcohol is completely evaporated. This substance is readily attacked by fuming nitric and by concentrated sulphuric acids; and it burns readily with a luminous smoky flame. On trituration with water it breaks up into a flocculent yellow powder which on drying on the water bath fuses into a hard brittle mass.

"The substance extracted with alcohol when heated with caustic soda gives off very slight ammoniacal fumes.

"From the residue left after treatment with alcohol, a considerable quantity of a black pitchy substance can be extracted by means of benzene upon evaporating off which the black substance hardens and becomes very brittle. This substance also burns with a smoky flame.

"On heating some of the original powdered substance in a retort the organic matter fuses; and water having an acid reaction distills over, together with an oily liquid smelling slightly of acetone. If the heating is continued, the organic matter in the retort eventually clears; but if the heating is stopped before this point is reached and the fused mass poured out and allowed to cool, a hard black cake is formed with a lustrous black outer surface and a dull brown rough fracture.

"Turpentine also extracts a small amount of organic matter from the substance.

"I can see no reason to suppose that this is more than a local preservation of decomposed vegetable and animal refuse which might well have accumulated in the neighbourhood of a village such as is stated, according to native tradition, to have formerly existed on this spot, and which is borne out by the fact of potsherds being found buried there together with the organic deposit.

"It certainly bears no resemblance to petroleum. It could be used as a local fuel, like cow-dung, or as a coating for roads in the same way as asphalte is used for that purpose; but for this the supply is evidently all too small."

The following extract from Part III., Manual of the Geology of India, page 125, will complete the information available:—

"*Alwar.*—Tijarah, Lat. 27° 56′; Long. 76° 54′.—Close to Tijarah, in the Alwar State, and about 30 miles north of the city, the discovery of a

bituminous deposit was reported in the year 1874. Its mode of occurrence was thus described by Dr. Ffrench Mullen, Surgeon to the Agency:—

"'It was found in two fields, which are about 20 feet above the level of a road which runs east by south to the Ladloara fort. The substance was first turned up by the plough and was found to be combustible. It lay in patches in the soil of from 3 to 4 inches thick, and at an average depth of 3 inches from the surface. Trenches cut across the fields did not prove the existence of a greater thickness anywhere.

"'Samples of this substance, which were forwarded to the Chemical Examiner, North-West Provinces and Oudh, yielded 25·56 per cent. of bitumen and 3·72 of fixed carbon. Other samples forwarded to the Geological Survey Office yielded from 30 to 60 per cent. of combustible matter.

"'According to native tradition, the spot had been the site of a *bathan* or cattle village. It was suggested at the time that the deposit was due to infiltrations from animal and vegetable refuse; but the locality does not appear to have been visited by any one qualified to give a definite opinion. It seems probable that a true bitumen was formed by the alteration of the *cellulose* of an accumulated mass of vegetable matter, in contact with a saliferous soil. The facts do not justify the conclusion that the discovery had any real value, and it is chiefly in consequence of its having given rise to a considerable amount of official correspondence that it is mentioned here.'"

These reports are quite sufficient to settle the question of the non-existence of petroleum at or near Tijarah; while, as stated, the substance found there—even if it did burn better—is too small in quantity to be thought of as an industrial product worth consideration.

It is not clear however, after all, whether the substance last brought to notice by Mr. Ball in his letter, No. R. S. and C. 1262, dated Dublin, 3rd September 1887, to the Under-Secretary of State for India, is really the same as that we know of from Tijarah. Mr. Ball calls it "a clay highly charged with bitumen, and which burns freely," and further, there is a suspicion that, in possible default of being able to give in the first instance more definite information of locality than "the neighbourhood of Delhi," the donor of the specimen may have jumped at the suggestion of Tijarah. Under this view, it may be that the specimen came from some other part of the neighbourhood of Delhi, or Alwar, or Rajputana, and it might be as well to enquire further about the specimen and its constitution. In the meantime I am having all enquiry made in that part of India.

VOL. I.; PART I.; (NO. 8) 1888-89.

SELECTIONS FROM THE RECORDS

OF THE

GOVERNMENT OF INDIA,

REVENUE AND AGRICULTURAL DEPARTMENT,

BY THE

REPORTER ON ECONOMIC PRODUCTS.

Correspondence regarding the uses of the common wild plant ADHATODA VASICA, *Nees*, which will be found to contain much valuable additional information to that contained in the "Dictionary of the Economic Products of India," Vol. I. A., No. 484.

ADHATODA VASICA.

INTRODUCTORY REMARKS.

The writer having been informed by cultivators near Simla, that the leaves of **Adhatoda Vasica**, in addition to being a valuable manure for rice, possessed the further property of killing weeds, thought this discovery of sufficient interest to be the subject of a brief note for submission to the Government of India. The suggestion therein contained met with approval that the note might, if distributed to Local Governments, be found useful and probably call forth other new facts regarding the plant. The result has more than fulfilled the most sanguine expectations. The reputed property of killing weeds has in only a few instances however been confirmed; in others, it has been questioned; but many local officers repeat the statement that the plant is specially selected for use in the construction of wells, and its merit for such a purpose still remains an unsolved problem. The medicinal virtues of the plant are reiterated from every corner of the empire; and several of the officers whose reports are here reproduced speak of the leaves as employed to ripen fruit. This is a most curious and interesting fact, confirming the writer's suggestion, that it would be highly desirable to have the chemistry of the plant worked out, and its properties traced to its peculiar chemical constituents.

ORIGINAL NOTE.

Adhatoda Vasica, *Nees; Fl. Br. Ind. IV., 540;* **Acanthaceæ.**

Vernacular names, *Arusa, adalsa, adarsa,* Hind. and Bomb; *Bakas,* Beng.; *Adusa,* Guj.; *Arátorá,* Duk.; *Basuti, basoti bashi, tora bujja, bekkar.* or *pekkar,* Pb.; *Bashangarus,* Kumaon; *Arus, vasaka,* Sans.; *Rus,* Oudh; *Basung,* Uriya; *Adhatoda,* Tam.; *Adasara,* Tel.; *Teeshæ,* Angami Naga; *Kath, alesi,* Nepal; *Maya, yethaṉyi,* Burm.; *Agaládára, Pawetta,* or *Wanapalla,* Ceylon.

Habitat.—A small sub-herbaceous bush, generally gregarious (covering large tracts of country), found everywhere in Bengal and Assam, becoming less abundant as it extends across the plains to the Panjáb on the one hand and to Madras on the other. It is also much less frequent in Bombay; but

ADHATODA VASICA.

it occurs from Bengal, through Orissa and Chutia Nagpur, to the Central Provinces and Bombay. The *Flora of British India* states that the plant occurs from the Panjáb to Assam, Ceylon and Singapore,—"common and frequently cultivated." With the exception of some parts of the Bombay Presidency the plant is too abundant a weed to be anywhere cultivated (see pp. 72 and 78). In addition to its distribution over the plains, it occurs on all the lower mountain ranges and along the entire length of the Himálaya, ascending the hotter valleys to an altitude of about 4,000 feet above the sea. **Mr. Baden Powell** remarks: "It is quite the characteristic plant of the lower hills." From Kalka, and for several miles along the road to Simla, scarcely anything else is to be seen; and this is pretty nearly the case with the lower portions of nearly every road leading to hill stations. It would, indeed, be difficult to mention a more common and at the same time a more widely distributed plant.

Economic Properties and Uses.

A yellow *dye* is said to be extracted from the leaves by boiling, but the colour is not of much value in itself, although, with indigo, it affords a useful greenish-blue.

Medicine.—The leaves and the roots are supposed to be valuable in the treatment of coughs; and for this purpose they are administered along with ginger. The late **Dr. U. C. Dutt** wrote that there is a proverb, that no man need despair from phthisis, "so long as the Vasaka plant exists."

The flowers are supposed, when taken internally in the form of a decoction, to possess useful bitter and anti-spasmodic properties. A poultice of the fresh flowers applied to the eyes is reported to afford relief in acute ophthalmia.

The stems afford a good charcoal, which may be employed in the manufacture of gunpowder. This fact was first published by **Dr. Roxburgh** about the beginning of the present century; and shortly after **Dr. Ainslie**, in his *Materia Indica*, discussed the properties of two or three allied plants, attributing to them the medicinal virtues now restricted to this species. More recent authors have added that cases of poisoning are on record where a preparation from this plant was thought to have been administered. All these facts go towards establishing the idea, that the plant may possess a powerful active principle, the chemistry of which has not apparently as yet been investigated. The strong oppressive smell of the leaves would alone suggest this; and it would seem that the properties above briefly narrated were known to the Sanskrit writers many centuries ago. In most of the rural parts of India the plant enjoys the reputation of being a valuable drug for cattle; but, except in this form, no animal will, as a rule, eat the plant, although the goat has been known to occasionally do so.

In the course of the preparation of the *Dictionary of Economic Products of India* numerous reports were received from a large number of European and Native physicians, which afforded additional confirmation of the virtues commonly attributed to this plant; and there can, therefore, be little doubt but that in the domestic pharmacy of India it is largely employed.

Passing over a gap of some fifty years, the history of this plant had added to it little of any importance until the appearance of the *Oudh Gazetteer*. In that work there occurs the following passage:

"The *Rus* is extensively employed in the construction of the fascine-like supports of mud wells. The smaller branches are exceedingly pliant, and are worked round and round in a sort of neat triple plait. The leaf is held to possess high qualities as a manure, and is scattered over the fields just before the rainy season commences. It is then worked into the soil with the plough, and left to decay with the moisture, and thus form mould. As fuel, it is almost exclusively used in the process of boiling down the cane-juice; and is collected into large heaps some days prior to cutting down of the sugarcane."—(*Oudh Gaz.*, *III.*, 72.)

During a brief botanical excursion tc Suni on the Sutlej valley (north of Simla), the writer witnessed the cultivators scattering the leaves of this plant

ADHATODA VASICA.

over recently flooded fields, which were being prepared for the rice crop. Concluding that the same ideas prevailed in the Sutlej valley as in Oudh, with regard to some special virtue over any other plant, which the leaves and twigs of this bush possessed as a green-manure, the cultivators were asked whether the manure they were adding was only given to rice land or to other crops as well. This question seemed to afford amusement; and the cultivators hastened to explain that the *basúti* was not given alone as a manure, but also as a medicine or poison to kill the aquatic weeds that otherwise would greatly injure the rice crop. They pointed to fields that had been treated in this way; and there could be no mistake these were clean or free from the green scum caused through floating duckweeds (**Lemnas**) and submerged *Charas*. It was further explained that, before flooding the field, it was carefully manured with farmyard manure; then flooded, the water in a few days becoming green through the growth of the weeds. When all the weeds which the soil or water were likely to produce had sprung up, a cultivator, with a large apron in front of him, full of the cuttings of *basúti*, each about six inches in length, walked through and through the flooded field, sowing or scattering the *basúti*, until at a distance the field looked as if a crop of some plant, not unlike tobacco, was being grown in water. After a time these twigs are supposed to impart an objectionable flavour to the water, which completely kills the aquatic weeds. The *basúti* is then gathered off the field; and the rice crop sown or transplanted into it, as the case may be. Sometimes the *basúti* is ploughed into the soft mud, and thus made to act as a manure. Instead of *basúti*, when a green manure alone is desired, the leaves of the *Toon* (**Cedrela Toona**) or the *Neem* (**Melia Azadirachta**) are employed; but these, with the *basúti*, are the only plants employed as green-manure in the Sutlej valley. In all these cases it will be observed that plants which possess powerful properties are employed in place of numerous other weeds, which might more conveniently be employed. This same idea seems to prevail in many other parts of India—as, for example, the almost universal opinion, that the leaves of **Calotropis gigantea**, the *ák* or *mádá* (a plant with a most powerful milky sap), is a valuable manure for rice land, and a specific against the injurious growth of *reh* efflorescence.* It is difficult to understand what particular merit this green manure could have, over any other green-manure, in neutralising the *reh* salts, but, as remarked, the idea that it does possess some such property is very wide spread in India. It is thus noteworthy that the green manures in most general use in India are, like the *basúti*, as far removed chemically and botanically as they well could be from the crop intended to be cultivated, and are plants with powerful active principles.

It has occurred to the writer that it may be possible the same practice, and with the same object as recorded in the Sutlej valley, may be followed in Oudh and in other parts of India, and that the merit attributed to the *basúti* as a green-manure is not, strictly speaking, deserved. It, at least, seems more natural to suppose that the strongly fœtid-scented leaves would impart an injurious flavour to the water, sufficient, as believed in the Sutlej valley, to kill aquatic weeds, than that a few twigs of this plant could have a special merit as a manure. If this supposition prove correct, it may further be found that the habit of using the plant in the construction of wells is connected with the knowledge that the green scum so common on every sheet of water in India will not be formed in the presence of a few twigs of this plant. This idea is, however, only thrown out as a suggestion, in the hope of directing attention to the subject; for it may be found that a plant with such strong properties should in the construction of wells rather be discouraged than encouraged—at least in the case of wells intended for drinking purposes. If it be the case that the *basúti* leaves have the power to destroy the injurious weeds found in submerged fields, it would seem desirable to make this fact known, since, as far as the writer is aware, this property is not understood outside the limits of the Sutlej, or perhaps of one or two neighbouring valleys in the North-West Himálaya.

* Conf. with No. 19 Silk-Cotton under **Calotropis gigantea**.

ADHATODA VASICA.

Indeed, it is quite possible that this extremely plentiful plant, when its properties are fully examined, may prove to be capable of further development. For example, a decoction of it might be found useful in destroying animal pests to other crops, such as sugarcane, tea, and coffee.

In the meanwhile it seems desirable that enquiries should be made in different parts of India regarding the practice of applying the plant to the field; and the reason why it is so used, and why, also, it is chosen to bind the sides of wells.

SIMLA, GEORGE WATT,

The 22nd June, 1887. *Reporter on Economic Products.*

AFGHANISTAN.

Manure.

Hastens Germination.

NOTE.—Since the above was published, the writer has accidentally come across one or two passages in **Dr. J. E. T. Aitchison's** *Kuram Valley Flora*, which are of interest as pointing to the belief in the special merits of *Adhatoda* as a manure being held by the people of certain portions of Afghanistan. Speaking of the Kuram district, **Dr. Aitchison** says: "The germination of rice-seed in the seed-nurseries is supposed to be hastened by shading with the young branches of **Adhatoda Vasica** and **Sophora mollis.**" Again, of Thal and Badishkhel he writes: "The young leaves of **Adhatoda Vasica** are largely collected and mixed with the grain in the rice-nurseries, to hasten the process of germination by the heat generated during their decomposition." In nearly every province of India certain cultivators put great faith in green manure for rice; and in most districts the grain is frequently made to sprout before being sown. Some interesting information of this nature will be found in the *Mysore Gazetteer*, Vol. I., pages 52, 110, 112, and 113—the plants specially mentioned being **Calotropis gigantea, Dodonea viscosa, Mirabilis, Datura, Solanum,** and **Ocymum.**—[*Ed.*]

BOMBAY.

No. 1728, dated Poona, 1st October 1887.

From—The Director, Land Records and Agriculture, Bombay,

To—The Secretary to the Government of India, Revenue and Agricultural Department.

With reference to Mr. Under-Secretary Lawrence's Circular No. 38-A—93-1, dated 14th July 1887, forwarding a Note by **Dr. Watt** on the plant known as **Adhatoda Vasica,** I have the honour to forward copies of replies from the marginally noted officers and gentlemen, to whom a reference on the subject was made.

Conservator of Forests, Northern Circle.
Conservator of Forests, Southern Circle.
Dr. T. Cooke.
Dr. J. C. Lisboa.
Surgeon-Major Gray.

Infusion used to kill insects.

2. From the accompaniments it will be seen that "Adulsa," though it may not be so common as in Bengal, is well distributed in this part of the country, and is much more prized for its medicinal virtues than for agricultural use. The only particular purpose for which "Adulsa" is used in agriculture is for an infusion of *Adulsa* and tomato leaves, which is sprinkled over the young seedlings of cabbages, knolkhols, &c., to kill insects. Nothing is known about its weed-destroying properties. The officers of the Agricultural Department have been requested to make special enquiries as regards the usefulness of the plant for agricultural purposes.

No. 2544, dated Poona, 10th August 1887.

From—The Conservator of Forests, Northern Cricle, Bombay,

To—The Director of Agriculture, Bombay.

With reference to your letter No. 1281, dated 26th ultimo, forwarding copy of a Note on the **Adhatoda Vasica** by **Dr. George Watt,** and requesting the

ADHATODA VASICA. BOMBAY.

expression of my remarks upon "the several points touched in the concluding portion of the Note," I have the honour to inform you that the "Adoolsa" is not uncommon in the Poona district, and is to be found growing abundantly in the Konkan, where it is held in high estimation by the people on account of its several valuable properties very serviceable to the farmer.

Manure in Rab cultivation.

2. Although I have never heard that the **Adhatoda Vasica** can be used to kill aquatic weeds simply by immersing leaves and branches of it where such weeds prevail, still I am aware that it is used for *rab* in the ordinary way for rice fields, and that the leaves are much prized for their manurial value in connection with the cultivation of vegetables and fruit; and moreover, that an infusion of Adoolsa and Tomato leaves combined is applied to cabbages, knol-khol, and other vegetables, in order to kill the insects, which feed upon the young seedlings.

Medicine.

3. Several important medical properties are assigned to the Adoolsa. A cough mixture for children is made from the roots and leaves; and a decoction is used in fever and ague, for diarrhœa, dropsy, and headaches, &c.

Dye.

4. A dye is extracted from the leaves, which is used for colouring turbans; and it is likewise used for colouring tobacco.

5. The leaves supply fodder for cattle.

Advantages to Forestry.

6. If *rab*, as used in rice cultivation, is especially valuable for the destruction of weeds effected by its agency, and if the Adoolsa possesses the like property of destroying weeds, then I am of opinion that the planting of the Adoolsa upon all waste lands and on the boundaries of fields, &c., should be encouraged as much as possible; and that it is an imperative duty of your Department to verify the statement that the **Adhatoda Vasica** has such weed-destroying power: for should this become an established fact, then the lopping of trees, involving the destruction of woods and forests for rice cultivation, will probably be decreed by your Department also to be an unnecessary luxury, as superfluous as it is barbarous.

No. 2795, dated Belgaum, 13th September 1887.

From—The Conservator of Forests, Southern Circle, Bombay,

To—The Director of Agriculture, Bombay.

In reply to your No. 1281 of the 26th July 1887, I have the honour to inform you that the **Adhatoda Vasica** appears to be common in Dharwar and Belgaum; but it is not, so far as I have been able to ascertain, used for manure, nor for destroying insects nor weeds. It does not appear to be a jungle plant. **Mr. Talbot** informs me that it is extensively used for hedges in Dharwar.

No. 291, dated Poona, 5th August 1887.

From—Dr. T. Cooke, Principal, College of Science, Poona,

To—The Director of Agriculture, Bombay.

Medicine often chewed in *pán*.

With reference to your letter No. 1281, dated 26th July 1887, with accompaniment, I have the honour to state that **Adhatoda Vasica**, known to the natives here as "Adulsa," is commonly grown about villages; but it is not sufficiently common in the Deccan to be used for the purposes mentioned in **Dr. Watt's** Memorandum, even if it possessed the properties therein ascribed to it. It is a well-known native remedy for colds and coughs; and the leaves are often chewed with betel leaves as a remedy. It is very doubtful that the effect ascribed by the cultivators to this plant were produced by the plant, or would be produced by any special plant. The rice fields in the Konkan are during the month of November full of weeds, and are ploughed repeatedly with the object of destroying them, and getting manure from the crushed leaves and

ADHATODA VASICA. BOMBAY.

stems. Any plant that was readily available would, no doubt, be used as green-manure in a like manner, if weeds were not abundant in the fields.

From—Dr. J. C. Lisboa,

To—The Director of Agriculture, Bombay.

Cultivated.

With reference to your letter No. 1281, dated 26th July last, I have the honour to inform you that the shrub *Adulsa* (**Adhatoda Vasica**) is cultivated in many a garden of the natives of Bombay as an ornamental and useful medical plant, and cultivated and used for hedges around bungalows and houses, perhaps from its not being deciduous. Some of the houses of Khandalla and Lanoly are thus surrounded by the plant. It grows wild in many places of this Presidency, though not so abundantly as in Bengal. Its medicinal properties

Medicine.

and uses are well known to the natives of Bombay, and are also mentioned in the *Indian Pharmacopœia*, edited by **Mr. Waring**. I have myself administered successfully its leaves in the form of pills in some cases of bronchitis, both acute and chronic; and I am not aware of any cases of poisoning caused by the drug.

Neither the leaves nor the young branches are employed in this Presidency in the way and for the same purpose as in the Sutlej valley; and my own observation and information received from various sources lead me to believe, that the people of this side of India are ignorant of the usefulness of the leaves of this plant as a green manurial agent, and of its properties of destroying the low forms of vegetable and animal life.

Not used as manure.

The leaves of the *Toon* (**Cedrela Toona**) and of *Neem* (**Melia Azadirachta**) are not, so far as my enquiries go, employed in Bombay as a green-manure; but if they have ever been used as such, I think they act also in destroying the formation of aquatic weeds and insects. The bark of the "Toon" was, and is still, used by some *vaids* for the cure of malarious fevers. **Dr. Roxburgh** says: "The bark (of Toon) is a powerful astringent; and though not bitter, is a tolerably good substitute for Peruvian-bark for the cure of remittent and intermittent fever, especially when conjoined with a small quantity of the powdered seed of **Cæsalpinea Bonducella**, the *Katkaleja* of Bengalis (*sagargota* of Bombay), which is a most powerful bitter." The wood of Toon is not attacked by white-ants, the aromatic resin or principle contained in it being, it is said, obnoxious to this pest. The properties and uses of the bark

Properties of the Neem leaves.

of the *Neem* are well described in the *Indian Pharmacopœia*. It is generally administered internally in the form of decoction. The Gujarat people follow another plan of treatment in cases of low intermittent fevers of long duration, which consists in bathing themselves with an infusion of the leaves daily. Indeed, such is the belief in the efficacy of its virtues in the cure of the kinds of fever, that persons suffering from fever are said to sleep or lie down under the tree before the expected attack. I have tried the experiment with some of my patients. The leaves of the tree were scattered under the beds of my patients; and a bath of its infusion was used by them. The experiment appeared to have been successful; though the number of cases in which I tried was too small to warrant me to speak with certainty of the efficacy of this treatment.

Kills insects.

The wood is not attacked by insects. The powdered seeds are said to be used for washing the hair, and killing insects, lice, &c. The bark in the form of decoction, and the acrid oil (called *margosa* oil) extracted from the pulp of the drupes, are administered as a vermifuge (see my book, *Useful Plants of the Bombay Presidency*, which forms part of the *Bombay Gazetteer*, Vol. XXV). The leaves of the *Neem*, and also, I believe, of the *Toon*, are dotted with pellucid spots or vesicles, containing a pungent aromatic volatile oil, which, together with some acrid principle found in the branches, seeds, and drupes above mentioned, possesses I daresay the property of checking, to some extent, the luxuriant growth of low form of vegetable and animal life, as well as of neutralizing the malarious poison.

Common wild plant Adhatoda Vasica.

ADHATODA VASICA.

BOMBAY.

I have seen in Damaun the green leaves and young trunks of *Erund* and *Jepal* (**Jatropha Curcas**) used as a manure for cocoanut trees; and the owners of cocoanut plantations in Goa use for the same purpose the leaves and the shoots of the *ukshi* (**Calycapteris floribunda**) and of *wad* (**Ficus bengalensis**). Towards the end of the month of May, holes about 2 feet deep and 2 feet wide, are dug around the roots, and the green branches of one of the above mentioned plants are buried in and covered over with sand and mud or silt from the beds of fresh river water or from creeks, which contain sea water mixed with river water.

Green manure.

An experienced and educated man gave it as his own opinion that the leaves of the *ukshi*, being thick, very likely contained a larger proportion of the manurial principles useful for the cocoanut trees. This was the only reason, he would venture to say, why *ukshi* was used in preference to other trees. He was not aware that this plant has any properties of destroying weeds and small insects.

TANJORE.

Mr. Mutwsoami, G.M.M.C., F.L.S., in his paper on "Indian Materia Medica" (see *Indian Medical Gazette*, January 1887) says: "The leaves of the *Karanj* (**Pongamia glabra**) are extensively used as a manure for paddy fields in Tanjore." He, too, makes no mention of its property of destroying the aquatic weeds. The leaves of the *karanj* are thick, but not more so than those of many other trees. The oil of the seeds is, however, a very good medicine employed for the cure of various skin diseases, such as itch, lepra, and even ring worms, which last is, as it is well known, caused by the presence of a vegetable parasite. A medical gentleman, who is an acute observer, and who resided in various parts of this Presidency, writes from Igatpuri: "I find that *Adulsa* is not used here for manurial purposes of the paddy fields."..... ....." I know of a plant which is used in some parts to kill the crabs of the paddy fields, which destroy the rice seedlings. It is called *Saratta*. The leaves of this plant are loosely rammed into the crabholes; and I understand that the stink of the leaves destroys the crabs. Under such operation the crabs get out of the holes, and die." The plant above mentioned was identified by me as **Tribulus terrestris**, from the native name above given. It is a desert plant, common in Poona, and known here also by the name of *Gokru*. The *stink* of the little herb is not very noticeable. Perhaps, it possesses some principle injurious to the crabs, which infest the paddy fields in some parts of India.

Oil kills insects.

Plant used to kill crabs in rice fields.

Dated Bombay, 29th September 1887.

From—SURGEON-MAJOR W. GRAY,

To—The Director of Agriculture, Bombay.

In reply to your No. 1281, dated 26th July 1887, I have the honour to state that I am not aware of the plant **Adhatoda Vasica** being employed for agricultural purposes on this side of India, as described in the concluding portion of **Dr. Watt's** Note. I have made enquiries on the subject here, and cannot learn that the plant is so used. As regards the peculiar properties attributed to it, I am not able to offer an opinion, either one way or the other, without experiment.

The plant is common on the Ghats and in Guzerat, but is less so in the Konkan.

BURMA.

No. 385-44-A, dated 17th November 1887.

From—The Chief Secretary to the Chief Commissioner, Burma,

To—The Secretary to the Government of India, Revenue and Agricultural Department.

With reference to your letter No. 38-A—93-A, dated the 14th July 1887, with its annexure, on the subject of the plant known as **Adhatoda Vasica**, I am directed

ADHATODA VASICA. BURMA.

to submit, for the information of the Government of India and for communication to **Dr. Watt**, a copy of a Note, dated the 29th October 1887, by the Director of Land Records and Agriculture, Burma, containing a digest of the information that has been obtained regarding he uses to which the plant is put in this Province.

Note by the Director of Land Records and Agriculture, Burma,—dated the 29th October 1887.

The plant **Adhatoda Vasica** appears to be found throughout Burma.

Medicine. Not as a manure.

It is used medicinally, but not as manure, nor for the purpose of killing weeds, nor in the construction of mud wells.

The Conservator of Forests (Pegu Circle) writes that the plant is called "maya" by the Burmese, and that it is only used medicinally. **Mr. Hoghton** (Deputy Conservator) reports that Burmans pound the leaves, and use them as a poultice for fresh wounds; while an infusion of the leaves and twigs is given internally for coughs. **Mr. Hardinge**, Secretary of the Agri-Horticultural Society, also reports that the leaves are used for medicine.

The Conservator of Forests, Tenasserim, reports that the plant is abundant in several parts of his circle, and that it is there known as "Yethagyi." He says it is used as medicine—externally, in cases of swellings, bleeding from the nose, and headache; and internally, for fever, colic, asthma, and dysentery.

MADRAS.

Extract from the Proceedings of the Board of Revenue, Revenue Settlement, Land Records and Agriculture, Madras,—No. 166, dated 10th April 1888.

Read again Proceedings of the Board of Revenue (Revenue Settlement, Land Records and Agriculture), dated 25th July 1887, No. 236.
Read also the following papers :—

From the Collector	of	Anantapur,	dated	19th Nov.	1887,	No. 750.
" "	of	Arcot, North,	"	17th "	"	" 573.
" "	of	Arcot, South,	"	5th Feb.	1888,	" 10.
" "	of	Bellary,	"	1st Nov.	1887,	" 454.
" "	of	Canara, South,	"	6th "	"	" 3682.
" "	of	Chingleput,	"	6th Oct.	"	" 1583-Ind.
" "	of	Coimbatore,	"	3rd Nov.	"	" 986.
" "	of	Cuddapah,	"	18th "	"	" 1520-F.
" "	of	Ganjam,	"	15th "	"	" 5347.
" "	of	Godavari,	"	12th "	"	" 51.
" "	of	Kistna,	"	23rd "	"	" 5895.
" "	of	Kurnool,	"	28th Oct.	"	" 478.
" "	of	Madras,	"	12th "	"	" 3451.
" "	of	Madura,	"	17th Nov.	"	" 683.
" "	of	Malabar,	"	17th "	"	" 6009.
" "	of	Nellore,	"	10th Jan.	1888,	" 112-For.
" "	of	Nilgiris,	"	7th Nov.	1887,	" 392.
" "	of	Salem,	"	3rd "	"	" 2726.
" "	of	Tanjore,	"	8th "	"	" 659.
" "	of	Tinnevelly,	"	9th "	"	" 726.
" "	of	Trichinopoly,	"	6th Oct.	"	" 441-4.
" "	of	Vizagapatam,	"	18th Nov.	"	" 2737.

RESOLUTION.—With their letter of the 14th July last, No. 38-A—93-1, the Government of India forwarded to the Board a Note by **Dr. Watt**, of the

Common wild plant Adhatoda Vasica.

ADHATODA VASICA. MADRAS.

Revenue and Agricultural Department, in which it was suggested that inquiries should be made in different parts of India as to the practice of applying the leaves and twigs of **Adhatoda Vasica**, or Malabar nut, to rice fields; and the reason why it was so used, and why also it was chosen to bind the sides of wells.

The application to rice fields of the leaves of this plant was, it was stated, intended to kill the aquatic weeds that would otherwise greatly injure the crop; while the use of the plant in the construction of wells was suggested to be due to its influence in preventing th e growth of the scum so common on every sheet of water in India.

2. **Dr. Watt's** Note was circulated to all Collectors for careful inquiry and report, and the letters read above are the replies to the reference.

Board's Pros., No. 236, dated 25th July 1887.

3. It is only in Nellore that the practice of applying the plant to rice fields, and using it to bind wells, is said to obtain; and the Collector has no doubt that the reason is, that it destroys aquatic weeds. He also states that natives place the leaves among clothes to keep off insects. In North Arcot it is reported that the belief exists, that in flooded lands the plant kills water-weeds. In some parts of this district and of Tanjore, the twigs of the plant are used to bind wells; but whether in the belief that it will prevent the growth of scum is not stated. In Chingleput the leaves are used, with those of other plants, as manure, and especially for saline soils, the leaves being supposed to counteract the saline properties of the soil. In the Vriddhachalam taluk of the South Arcot district and in some parts of the Kistna districts the application of the leaves as manure is believed to be beneficial to crops blighted or diseased. In the latter district the leaves are also used for covering wet seeds about to be sown for a second crop in order to induce sprouting. The plant is also grown in hedges round betel gardens to protect the creeper from the hot winds. In parts of Coimbatore, Tanjore, and South Arcot the leaves are applied to fields as manure; but they are only regarded as one of several kinds more or less suitable for the purpose.

In Nellore supposed to destroy weeds; keeps off insects from clothes.

Also in North Arcot.

Manure.

Wet leaves employed to induce germination.

4. The plant is held in great esteem throughout the Presidency for its medicinal properties. It is used in the treatment of fever, pulmonary affections, bowel and stomach complaints, tumours, rheumatism, syphilitic complaints, diseases peculiar to women after confinement, affections of the eye, and guinea-worm. A decoction of the roots is given in cases of slight leprosy.

Medicine.

5. In Vizagapatam, Anantapur, and Chingleput the plant is used in the treatment of cattle-diseases also.

Cattle-disease.

6. In Vizagapatam good fine charcoal, which is used for the manufacture of native gun-powder, is said to be obtained from this plant.

Charcoal.

7. The plant is apparently not known in this Presidency as a dyeing substance.

Not known as a dye.

ASSAM

No. 939, dated Shillong, 24th May 1888.

From—The Director, Department of Land Records and Agriculture, Assam,

To—The Under-Secretary to the Government of India, Revenue and Agricultural Department.

With reference to your No. 38A—93-1, dated 14th July 1887, forwarding a Note by **Dr. Watt** on the plant known as **Adhatoda Vasica**, I have the honour to forward herewith an account of the species as known in Assam prepared by **Mr. Mann, Conservator of Forests.**

Correspondence Regarding the Uses of the

ADHATODA VASICA. ASSAM.

No. 62-K, dated 8th May 1888.

From—G. MANN, Esq., Conservator of Forests, Assam,

To—The Director, Dept. of Land Records and Agriculture, Assam.

Medicine.

With reference to your letter No. 1612, dated the 12th November 1887, I have the honour to report that the plant referred to, **Adhatoda Vasica**, is very common in all the districts of Assam, except the higher hills. It is used chiefly, by all accounts, in the treatment of coughs and asthma. The juice which is extracted from the young shoots and flowers, by first roasting them in an ordinary brass or iron vessel over a fire, and then applying pressure, is taken with ghee or honey; and the flower and very young leaves are occasionally used in the same way, prepared as paste; and sometimes the leaves are said to be smoked, like a churoot, for cough.

2. The root of the plant is sometimes boiled with ginger, fruits of **Terminalia citrina**, or **Gmelina arborea**, or a few raisins, and then mixed with honey or sugar; and taken in a similar way as medicine for coughs and consumption.

3. Decoction of the leaves and bark are used against diarrhœa or dysentery and worms; also for skin diseases.

4. Honey from bees which feed much on the flowers of this plant is said in some parts of the Province also to be good for cough and asthma.

Charcoal.

5. The practice of using the charcoal obtained from the stems of this plant in the manufacture of gunpowder is in vague in this Province also.

6. The native name of the plant is "*Bahuk*," "*Tita Bahuk*," or *Bahika*; but there are two distinct plants known under this name, and used very much for the same purposes, the **Adhatoda Vasica** being called the *White Bahuk*, and **Phlogacanthus thyrsiflorus** the *Red Bahuk*.

No. 1113-A, dated Nagpur, 18th June 1888.

From—The Director, Department of Land Records and Agriculture, Central Provinces,

To—The Under-Secretary to the Government of India, Revenue and Agricultural Department.

CENTRAL PROVINCES.

Medicine.

Not a manure.

Referring to your Circular No. 38-A—93-1, dated 14th July 1887, and subsequent reminder regarding the plant known as **Adhatoda Vasica**, I have the honour to state that the plant occurs plentifully in the eastern portion of these provinces in the Sambalpur district and the tracts adjoining it, where it is known by the name of "*basang*." A decoction of its leaves is used as a remedy for cough, being sometimes mixed with ginger for the purpose. A poultice made of the leaves and juice is also used in cases of rheumatism. It does not appear to be utilised as a remedy for ophthalmia. It is one of the ingredients used in preparing the mixture in which infants up to the age of four months are bathed and which gives their bodies a yellow colour. The plant does not appear to be put to any agricultural use.

No 240-S, dated Simla, 14th July 1888.

PANJAB.

From—The Junior Secretary to the Government of the Panjáb,

To—The Secretary to the Government of India, Revenue and Agricultural Department.

I am directed to forward for the information of the Government of India a copy of a letter No. 1647, dated the 5th of July 1888, from the Director of

Land Records, Panjáb, together with its enclosed abstract of the replies of District Officers to the enquiries regarding the **Adhatoda Vasica** plant instituted in compliance with the Circular of the Government of India, No. 38-A—93-1, dated 14th July 1887.

No. 1647, dated 5th July 1888.

From—The Director of Land Records and Agriculture, Panjáb,

To—The Junior Secretary to the Government of the Panjáb.

With reference to the Government of India's Circular No. 38-A—93-1, dated 14th July last, received to my address direct (copy of which with enclosures is sent herewith), I have the honour to forward abstract of replies received from the District Officers through Commissioners of Divisions on the use of the plant known as **Adhatoda Vasica**; and to request that it may be forwarded to the Government of India.

Abstract of replies from Commissioners to this Office, No. 1829, dated 25th July 1887, for the use of plant known as **Adhatoda Vasica.**

DELHI DIVISION.

Hissar.—The plant is not seen in this district.

Rohtak.—The plant is used in this district for roofing. — Used for roofing.

A decoction of the flowers and the powdered ashes of the roots are also used in cases of asthma and chronic cattarrh. — Medicine.

Gurgaon.—The plant appears to be known as *Piya Bansa*, and is used for the manufacture of gunpowder and charcoal, and its leaves are considered to have healing power on wounds and rheumatic pains. — Charcoal.

Delhi.—Not known in this district.

Karnal.—This plant is well known under the name of *Bansa* in the Eastern Panjáb and in the outer Himálaya up to a certain elevation.

It is used in making fascines for lowering the masonry lining of wells, where it happens to be the nearest available material. — Fascines in wells.

Umballa.—Is known as *Bansa* and is said to be used as a blood purifier.

Simla.—In addition to **Dr. Watt's** discoveries it is used as a medicine for indigestion in conjunction with salt for mules, and unripe plantains are covered in the leaves of the plant as a *pál* or ripening process. — Employed to ripen plantains.

JULLUNDAR DIVISION.

Jullundar District.—The plant is called "*Busate*," and is used for purposes of medicine to some extent. The native hakims state that it is useful for phlegm, phlegmatic fever, hectic fever, cough, asthma, leprosy, &c., but chiefly for the two diseases of fever and cough; and its leaves form a component part of prescriptions for these diseases.

The medicine is prepared either in the form of a decoction or of powder. The decoction is prepared in the following manner: Take *Nilofar* (**Nymphea**), *Banafsha* (**Viola odorata**), *Unah* (**Zezyphus Jujuba**), *Lasurian* (**Cordia Myxa**), *Mulathi* (Liquorice), *Gund Kikar* (**Gum Acacia**), *Gund Katira* and *Basuti* leaves, soak them in water and boil them; having strained the boiled water, boil the mixture again in a syrup of sugar, and the decoction, when cool, is ready for use. The preparation is called *Sharbat Ajjas* in the vernacular. — Medicine.

The mode of preparing the powder is as follows:

Take a certain quantity of *Basuti* (root, branches and leaves), burn it to ashes, and having mixed it with water, strain it as the dyers do with *Kassumba*. The strained ashes should again be soaked in water and boiled over a mild

ADHATODA VASICA. PANJÁB.

fire till the water evaporates. The *Basuti* ashes thus prepared should be mixed with *Gund Kikar* (Gum Acacia), *Gund Katira*, *Mulathi* (Liquorice), *Kaddu* (Pumpkin) seed, and beaten to powder.

The Tahsildar of Phillour reports that it is also used along with other ingredients for making fireworks.

Manure.

Hoshiarpur District.—The plant grows in great abundance in and at the foot of the low hills and generally all over the district. It is used extensively as manure. It is also used as a febrifuge, the leaves being put in hot water, and the decoction therefrom drunk by the patient.

KANGRA DISTRICT.

Medicine.

Kulu Subdivision.—This plant called here *Basuti*, grows only in small quantities low down in the valley, and is used only for plasters, bruises, and sores.

Manure.
Used to extract the red colour from safflower.
Employed to ripen mangoes.
Detergent.
Tanning dye.
Charcoal.
Medicine.

Kangra itself.—The leaves of the *Basuti* are applied to the fields simply as a manure, and are used for covering safflower, in order to make it yield a valuable red colour, and ripening mangoes and plantains, which are kept covered by these leaves for a few days. The leaves when applied after being warmed a little, afford relief in boils, pain in joints, opthalmia, &c., and are valuable in hydrophobia. They are given as a medicine to cattle in case of pain in the stomach. The washerman burns the plant and uses the ashes for washing clothes as *sajji* (impure carbonate of soda). The tanner extracts a yellow colour from the leaves to dye skin. The smell of the leaves is known to prevent bleeding from the nose. The charcoal produced by burning the stems is used in manufacturing gunpowder. The roots are medically used for removing cough, bile, impurity of blood, asthma, fever, phthisis, vomiting, seminal weakness, costiveness, pain in the chest, enlargement of the spleen, gonorrhœa, syphilis, and unsteady eyesight (*Chanot*).

Lining for wells.

The Commissioner states that in addition to what is said above it is known to him that this plant is used by zemindars as a lining to support *kutcha* wells, and is frequently thus applied in the Rawal Pindi district.

LAHORE DIVISION.

Medicine.

This plant called *Basuti* grows in the Pathankot tahsil of the Gurdaspur district, where its leaves are used for medical purposes. It is not known apparently to be used in any way in the Districts of Mooltan, Jhang, Montgomery and Amritsar. It is not grown in the Lahore district, but the Tahsildar of Lahore reports that after great search a plant has been found in Shahderah gardens. The dried leaves of the plant are imported from Kangra, and used by hakims in the treatment of cough, &c., and the juice of its leaves is applied to remove worms in cattle. Mr. Elliot, District Forest Officer, Mooltan, reports that the plant is grown abundantly in the Rawal Pindi district, and used there in lime burning and in the manufacture of charcoal.

Cultivated.

RAWAL PINDI DIVISION.

Medicine.

The plant seems to be well known throughout the division (except in Gujranwala), and to be highly valued. It is commonly called *Bhekhar* or *Bhakhar*. It grows spontaneously and luxuriantly in the low hills in the Rawal Pindi district, and is found in the salt range in Shahpur. The plant is chiefly valued for its medical qualities. It is largely used for pulmonary diseases. A decoction of the leaves is said to be good for fever, the kidneys and in rheumatism. The roots are good for asthma, jaundice and nausea; if mixed with the rind of the plant and black pepper used for rheumatism and pimples. The seeds are used by the women of Sialkot to hang round children's necks as charms against chest diseases. The ashes of the roots and twigs are also supposed to be good for the eyes and chest. It is also

Charms.

ADHATODA VASICA.

used as a medicine for horses (but particulars are not given). In Sialkot stems pounded with *gur* are given in febrile diseases, and in Rawal Pindi it is said to be used for colic in horses and camels.

PANJAB.

As a manure it is used to a moderate extent in Rawal Pindi, but it does not appear to be used in this form elsewhere. It is used in Pindi for roofing houses by agriculturists, but is nowhere used in wells.

Manure.

Roofing.

In Sialkot a dye is said to be extracted from it. It is also used as fuel, and for the manufacture of charcoal used for making gunpowder.

Dye.

Charcoal.

Peshawar Division.

Peshawar District.—The plant is known as *Bahekar*, and is largely grown (*sic*) in this district, and is used in medicines as well as fodder for goats and camels.

? Cultivated Fodder.

Kohat District.—This plant is called *Bahekar*, and there are two kinds thereof in this district locally known as—

Bahekar Siah.

Bahekar Sufed.

The plant grows abundantly on the stony and hilly lands throughout the district, but it is never grown in the cultivated land. The black *Bahekar* is useful for phthisis, consumption, spleen, cough, wounds, and boils. The white *Bahekar* is used in colic wounds, also for *Zehrhad* (Anthrax) to horses. Its seeds are eaten in colic and its leaves are taken internally in the form of a decoction. In the treatment of anthrax its seeds are generally administered. Its leaves also afford relief in this disease when they are pounded up and given with salt. The leaves of black *Bahekar* are scattered over flooded fields (of irrigated land), which are being prepared for a rice crop, and the Zemindars state that by this means the yield of the rice crop is much augmented. Stems of black *Bahekar* afford a good charcoal, which is used in the manufacture of gunpowder. This plant is also extensively used as fuel.

Cattle-Disease.

As manure augments yield of rice.

Charcoal.

Hazara District.

This plant (*Bahekar*) is a common jungle produce in this district, and useful in the following ways :—

(1) To line *katcha* wells.
(2) As medicine for cattle.
(3) Flowers supply bees with honey.
(4) Its charcoal is used in gunpowder.
(5) As a poultice for boils.
(6) As fuel.

Lining for wells.

Medicine.

Charcoal.

Derajat Division.

Bannu District—Forwards some leaves of this plant known in the Mianwali Ilaqa as *Wahekar*. It grows on Sukesar hills and is administered in coughs, threadworms, retention of urine, and acute opthalmia.

Dera Ismail Khan.

Not found.

Dera Ghazi Khan.

Not found.

Muzaffargarh District.

Not well known and not used for any special purposes.

Correspondence Regarding the Uses of the

ADHATODA VASICA. NORTH-WESTERN PROVINCES.

No. 3452, dated Lucknow, 17th July 1888.

From—The Director, Department of Land Records and Agriculture, North-Western Provinces and Oudh,

To—The Under-Secretary to the Government of India, Revenue and Agricultural Department.

In reply to your reminder No. 488-A, dated 4th June 1888, I have the honour to enclose copy of a Note on the uses of "**Adhatoda Vasica**"—written by **Mir Mohamad Husain**, Assistant Director.

2. I regret the delay that has occurred. Enquiries were made, and a Note was written by the Assistant Director some months ago; but apparently the case was mislaid—probably in one of the camp *dâks*.

Note on the uses of **Adhatoda Vasica** *by Mir Mohamad Husain, Esq., Assistant Director, Land Records and Agriculture, North-Western Provinces and Oudh.*

The plant in question is called *Rusa* in this part of the country. It is very abundantly seen in many places here, specially in some districts of Oudh. It is chiefly grown (*sic*) on the both sides of footpaths near towns and villages, and specially on the old ruins of them. They, the plants, very often are seen covered with the parasitic vegetable called *amerbale* [**Cuscuta sp.** *(Ed. S.)*].

Charcoal.

The people know several uses of the same. They know that its charcoal is best for making gunpowder.

Ripening Fruits.

For seasoning fruits, such as mango, plantain, custard apple, &c., that is, to soften the half matured fruit, and to give them nice colour, the leaves of the plant are used, the fruits are covered with the layers of the leaves.

Roofing.

For this other stuff also, such as dry *tin*, straw, dry leaves of some other trees is also used, but *rusa* is considered the best; perhaps it may be due to its having a property of killing the fungoid germ, or at any rate not letting it develope soon. It is greatly used in thatching and in roofing huts.

Lining wells.

For agricultural purposes the best use of it is, in making temporary wells; they make a thick rope by twisting its branches, and from that they weave a cylinder, which they sink in place of a brick and mortar cylinder, in the well. The *rusa* wood stands water well and does not rot for years; therefore the people prefer using its cylinder instead of any other plant's twigs.

It is believed to stand without rotting for half a century. At first the water of a new well gives a very offensive smell, but soon gets wholesome, and is used for drinking.

Manure.

It has good manurial value also. Very often a *kharif* crop field, specially of rice, is seen covered with its twigs before being sown; it has some specialty for clearing foul land. Sometimes it is burnt, and the ashes are used for manure.

Cleans foul land.

Medicine.

The wood being flexible makes very good tooth-picks. Some say that for cholera it is a good medicine, but a plant called *Pea bánsa* perhaps of the same genus, which has got yellowish flowers, is used more for medicine.

BENGAL.

No. 1350, dated Calcutta, 16th July 1888.

From—The Director of the Department of Land Records and Agriculture, Bengal,

To—The Secretary to the Government of India, Revenue and Agricultural Department.

I have the honour to acknowledge the receipt of your Circular No. 38 A—93-1, dated the 14th July 1887, forwarding a Note by **Dr. Geo. Watt**

on the plant known as **Adhatoda Vasica**, and suggesting that enquiries be made with a view to ascertaining if the plant has the power attributed to it of killing weeds or possesses manurial properties.

ADHATODA VASICA. BENGAL.

2. In reply, I have the honour to say that from inquiries in Behar it appears that the plant is not recognized as a manure or a preventive of weeds, and that though experiments have been made of its power over ordinary weeds, they have failed.

Experiments have failed to kill weeds.

The plant is a recognized specific for coughs and allied diseases, and is also used as a medicine for intestinal worms.

Medicine.

3. The same report is submitted from Orissa, where inquiries have been made. It is also reported from this Division that the stem is converted into charcoal, which is used in the manufacture of country gunpowder, and that the fuel when used imparts a special flavour to sugar. A Mohamedan of some respectability also informed **Mr. A. K. Roy**, the Settlement Officer at Angul in Orissa, that amongst the poorer classes of Mohamedans the practice prevails in some parts of Bengal, of putting up cuttings from this plant at the corners of graves to prevent animals from approaching the graves and digging out the corpses.

Charcoal.

Imparts a flavour to sugar.

Mr. A. C. Sen, who has been making similar inquiries in South-Eastern Bengal, reports that the plant, commonly known in Bengal as *vasaka*, is largely used as a medicine, especially in diseases of the respiratory organs; and it is sometimes burnt to get charcoal in the manufacture of gunpowder, but that it is not used as a manure, nor in the manner described in **Dr. Watt's** Note.

Not used as a manure.

CONCLUDING REMARKS.

It may be admitted that the above valuable reports to some extent justify the belief that the plant possesses such properties as to merit a thorough chemical examination being made. The belief in its power to kill weeds may be fanciful, but still there remains its very generally recognised manurial property, its power in hastening germination and in ripening fruits, and its reputed merit in killing insects, together with its high reputation as a medicine for coughs and lung diseases generally.

SIMLA,
December 1888.

GEORGE WATT,
Reporter on Economic Products.

C. C. Press, Simla.—No. 621 R. A. D.—9-1-89.—310.

VOL. I.; PART. I. (NO. 9) ; 1888-89.

SELECTIONS FROM THE RECORDS
OF THE
GOVERNMENT OF INDIA,
REVENUE AND AGRICULTURAL DEPARTMENT,
BY THE
REPORTER ON ECONOMIC PRODUCTS.

A Note regarding certain Indian TANNING MATERIALS.

TANS.

INTRODUCTORY REMARKS.

At a Conference held at the late Colonial and Indian Exhibition in London, a number of gentlemen assembled to examine the Indian tanning materials. Samples were freely distributed among those present for the purpose of securing professional opinions, and, as the result, various reports have appeared in trade and commercial publications. Among these may be specially mentioned the Report issued by the Leather Section of the London Chamber of Commerce. Subsequent to the Conference, applications were received at the Exhibition for collections of Dyes and Tans to be placed in the museums of certain Industrial Institutions. In consequence, letters and reports have been received, which are deemed of such importance as to justify a selection of papers on certain tanning materials being now published.

While some of the Indian tans have, as indicated, been subjected during the past year or so to industrial and chemical examinations, other practical experiments have been set on foot by the various Governments of India. **Divi-divi** has been grown in Bombay, of which the samples sent to England have been highly commended. Information has also been collected regarding **Acacia** bark and pods of so extensive a nature, that a large volume might be issued on that subject alone. **Captain Wood,** Conservator of Forests, North-Western Provinces and Oudh, has carried out useful enquiries into the preparation of Tanning Extracts. That officer was one of the first to recognize that there were other woods and barks, besides Catechu, that might be boiled down to conveniently exportable extracts. Samples of the extracts prepared by him were shown at the Conference, and the idea of utilizing new tanning materials was thoroughly approved of. It was deemed unnecessary to endeavour to prepare Cutch from such trees as **Acacia Suma** and **A. Sundra,** since these are even less abundant than **A. Catechu,** and consequently their extracts could not be prepared at a cheaper rate than the Cutch so largely made in Pegu and Kumáon. It was not, in fact, considered necessary that cheap Cutch should be the sole aim of the exploration for new tans. There are many astringent substances rich in tanning materials, and it was recognised that the search became one for a cheap article that would not impart much colour, while possessing a fairly good proportion of some tanning principle. The

TANS.

colour which Cutch gives to the leather is the chief reason why Gambier is preferred by English tanners; but the Kumáon Cutch, which at the Conference was mistaken for Gambier until its character was explained, was by most of those present examined with apparent interest. The following extract from the Report of the Conference may be here given, since it refers to this and one or two other points of importance in connection with Cutch:

"At the present day Cutch is not much used by tanners: it is too expensive, and the leather made by its means exudes an objectionable salt. Gambier is, therefore, preferred. Catechu bark, however, was pronounced one of the best barks shown. It seemed to possess a large amount of tanning principle, and had the equally indispensable property of being pale-coloured.

"A very extensive collection of samples of the extract having been shown, a discussion took place with regard to the Kumáon form. **Mr. Proctor** and several other gentlemen present had never seen this before, and thought it likely to possess properties which the tanning industry had overlooked. Samples were distributed, and reports promised. Some of the redder and less gummy forms of Pegu Cutch were viewed as hopeful from a tanner's point of view.

Special Tanning Preparations.

"It was urged that what had been done with the **Acacia Catechu** should be tried with a large number of other trees. The opinion seemed to be that many plants which had been neglected would yet come to yield preparations similar to Cutch, and possibly cheaper, through being prepared from more abundant trees.

"The Cutch obtained from **Acacia Sundra** was viewed more as a curiosity than anything else. Chemically, it is the same substance as the ordinary Cutch; and since it is believed the tree is not so abundant as **Acacia Catechu**, it was thought undesirable to dwell further on this substance, except as an additional source of Cutch. It was pointed out that the difficulty in using Cutch as a tanning material was the fact that it imparted a pronounced colour to the leather, which was not always desirable."

ACACIA CATECHU BARK.

(Conf. with Dictionary Economic Products, Vol. I., 27.)

CUTCH BARK.

The opinion was unanimously expressed, that much valuable material had been for years destroyed through the bark of the Cutch tree not being utilized. The pale colour of the bark and its apparent richness in tannin were characters that seemed to warrant high expectations that an extract of the bark, or even a carefully dried powder, would find a ready market. This seems therefore a subject that might with advantage be commended to the Cutch makers. An experiment or two might indeed be undertaken by Government to ascertain the cost of producing a bark extract or a bark powder. It is possible that the expense of boiling down the bark might not be repaid by the price obtained. But this is a point that could only be solved by careful experiment; and if it proved to be not sufficiently remunerative, attention might then be turned to the preparation of a powder from the rejected bark, similar to the powdered pods of **Acacia arabica**, an article which may now be said to have found a distinct market. (*Conf. with p. 107.*)

ACACIA ARABICA.

(Conf. with Dictionary Economic Products, Vol. I., 18.)

BABUL BARK AND PODS.

The following passage from the Report of the Conference (Colonial and Indian Exhibition) regarding **Acacia arabica**—the *babúl* or *kikar*—may be viewed as instructive:

TANS FROM ACACIA.

"The gentlemen present were of opinion, that if it were possible to induce some Indian firm to prepare from the pods an extract similar to Cutch, a trade might be started in this product. The difficulty in the way of opening up trade in tanning materials was one of freight. It is essentially necessary to reduce tanning materials to their smallest possible bulk and weight; and the opinion was given that much could be done in this direction by ascertaining how far it was possible to produce extracts, either in a dry condition like Cutch, or in the form of a liquid or prepared powder.

"It was suggested that it would be preferable to keep the preparations of the bark distinct from the pod; and in preparations of the pod it was recommended that, if possible, the seeds should be rejected, as they would be injurious. **Dr. Watt** drew attention to the fact that in a recent communication from the Berlin Leather Trades Association, fresh interest had been created in the Acacia (or *babla*) pods, owing to the light grey colour they impart to sheepskin."

POWDER AND EXTRACT.

It seems possible that simple machinery might be designed to crush the dry pods, and remove the seeds. By so doing, the value of the tanning material would be greatly enhanced, at the same time that a large quantity of a useful cattle food would be secured. Indeed, the value of the pods as a tanning material is greatly depreciated through the action of the weevils that literally riddle the pods in order to reach the seeds. In the correspondence published on a further page regarding **Divi-divi** (page 102) **Messrs. P. and S. Evans & Co.** make the suggestion that the Australian **A. pycnantha** should be introduced into India. There would seem little to justify the conclusion, that this would succeed better than the common *babúl*, unless it be established that the Australian plant is so much superior from a tanner's point of view as to justify a special effort being made. Regarding the peeling of *babúl* bark see the remarks at page 106.

Proposal to introduce the Australian Acacia.

ACACIA LEUCOPHLŒA.

(Conf. with Dictionary Economic Products I., 52.)

BARK.

The bark of **Acacia leucophlœa**—the *reru* or *safed-kikar*—attracted attention at the Conference; and the leathers exhibited from various districts in India as prepared by means of this material were considered superior to any others shown. These facts would seem to suggest the desirability of having experiments instituted with a view to determine the price at which an extract from this bark could be sold, and the annual quantity likely to be available. But just as with the bark of **Acacia Catechu** it might be found that it would not pay to extract the tannin, in which case it would become necessary to experiment with the production of a dry powder. The writer has no personal or practical acquaintance with the preparation of tanning extracts. A suggestion may, however, be here offered (and this occurred to him when the superiority in point of colour of **Acacia Catechu** bark as compared with the extract Cutch was under discussion at the Conference)—*viz.*, may it not be that the act of boiling down the chips of wood causes chemical changes by which the colour is produced? If this be so, then extracts from these barks might prove less valuable than the pulverized bark itself. But here, again, we are confronted with the necessity for careful experiments.

ANOGEISSUS.

(Conf. with Dictionary Economic Products, Vol. I., 256.)

BARK AND LEAVES.

The bark and leaves of the **Anogeissus latifolia**—the *dhává* or *dháurá*—and the leathers tanned by these were exhibited at the Conference.

TANS FROM MYROBALANS.

The following passage from the Report may be here given: "It was explained that these materials were extensively used in India, and that if found suitable for the European market, they could be more cheaply and extensively supplied than perhaps any other tanning substance found in India. The casual examination, however, seemed to suggest that, unless these could be prepared in the form of a condensed extract or fine powder, they were never likely to find a market in Europe. To export a large quantity of dried leaves appeared undesirable, the bulk and danger of ignition being almost prohibitive."

CASSIA.

(Conf. with Dictionary Economic Products Vol. II., 215.)

BARK.

The leather tanned by the bark of **Cassia auriculata**—the *tarwar*—was considered at the Conference much superior to what could have been inferred from the examination of the highly coloured bark. It was suggested that the same experiments should be tried with this substance as had been proposed in the case of **Acacia Catechu**, *viz.*, to prepare an extract and also a powder, and to furnish particulars as to the amount that might be annually available, and the prices at which these preparations could be placed on the home market. The same opinion was expressed with reference to the bark of **Chickrassia tabularis**—the Chittagong wood or *chikrássí, pabha*, &c., *viz.*, that unless it would pay the Indian dealer to prepare an extract for the purposes of exportation, it would be hopeless to expect this, or in fact any crude bark, to bear the freight and other charges so as to compete with the materials at present being placed in the home markets.

EMBLIC MYROBALAN.

(Conf. with the remarks at page 92.)

FRUITS AND LEAVES.

A few of the tanners present were familiar with the Emblic myrobalans—the fruit of **Phyllanthus Emblica**—*daula, ámla, aonta*—though they had never before seen the leaves. But the same objection exists with regard to these as has already been alluded to under **Anogeissus.** Unless a tanning half-stuff could be profitably prepared for export, it would be hopeless to expect a trade to be done in the leaves. They are doubtless good and useful tans, but have to compete with others that can be landed in the home markets at lower prices. This argument seems perfectly just and applicable to the leaves, but since it pays to export the fruits of the true myrobalans, it would seem as if the question of a future trade in the Emblic myrobalan would turn on the percentage of tannin which it possesses, and the colour it imparts to the leather.

SOYMIDA BARK.

BARK.

In the Report of the Conference, it is stated that the bark of **Soymida febrifuga,** the *rohan* tree of Hindustan, and the *shem* of South India, "gained most favour of any of the tans shown at the Conference. The high amount of tanning principle which it seemed to contain, when taken along with the pale colour of the material, gave promise of an almost certain future. It was accordingly strongly recommended that experiments should be made with this tan, in preference almost to any other." With the possible danger of a limitation of the supply of **Cutch** which the greatly increased demand for that extract is causing, it was recommended by the gentlemen assembled at the Conference that an effort should be made to discover a good substitute; and although these gentlemen urged that several plants should be experimented with in order to discover a good Cutch substitute, the *rohan* met with the highest commendations. And it may be remarked that even were it found to be as

convenient to extend the cultivation of **Acacia Catechu** itself as to adopt a substitute, it was urged there were drawbacks against Cutch, which would justify the experiments suggested.

NEW TANNING EXTRACTS.

In the preparation of extracts by **Captain Wood**, to which incidental reference has been made, and of which the Inspector General of Forests has been good enough to supply this office with a copy of the correspondence, the Sál (**Shorea robusta**) and the *Asna* (**Terminalia tomentosa**) are the trees being experimented with. The former has long been known to afford a strong tanning material; and the latter, while belonging to a family the fruits of which are known to tanners as myrobalans, has not obtained the same reputation as that of the sál. Its fruits are so inferior to those of **T. Chebula**, the true myrobalan, that they are not even used as an adulterant in the preparation known to the trade as "ground myrobalans." At the same time the *Asna* bark is rich in tanning materials, and thoroughly deserves to be carefully investigated. In a further paragraph the subject of **Captain Wood's** experiments will be reverted to; but meantime it may be added that, when opportunity occurs, it would be desirable to have the same experiments performed with all the barks, fruits, and leaves, to which reference has been made in this brief review of recent investigations with Indian tanning materials. **Captain Wood**, however, advances an argument (in favour of the trees now under his examination) which is so powerful as to scarcely admit of any difference of opinion. These trees are abundant in certain forests that are being cut up by railway extensions. Immense quantities of the bark are thus likely to be completely destroyed, if not utilized in the manner proposed.

TERMINALIA—MYROBALANS.

The above brief allusion to myrobalans suggests the desirability of republishing in this place a passage from the Report issued at the close of the Tanning Conference held at the late Exhibition:

"The gentlemen present were able to recognise and give the trade names for most of the forms exhibited. They pointed out that **Terminalia Chebula** must never be round or spongy in texture. The good qualities were known in the trade to be oval and pointed, and on section, of a pale greenish-yellow colour, and solid in structure. This oblong and pointed form was thought to be the product of a separate species, but **Dr. Watt** explained that, in his opinion, it was only the young or unripe fruit of **T. Chebula**.

Good and bad Forms.

"**Mr. Evans** kindly promised to furnish samples of the various commercial qualities, in order that these might be communicated to India, in the hope of an effort being made to disseminate a knowledge of what constitutes good and bad qualities. It seemed important, if the view was correct, that the oval and hard forms were but young fruits, that this fact should be published in India as widely as possible. The so-called Jubbulpur form of myrobalans was viewed as superior; and **Mr. Evans** picked out specimens of what he regarded as the best quality shown, in order to compare these with myrobalans procured in London. **Dr. Watt** explained that it was one of the numerous unaccountable eccentricities of trade, that, while thousands of square miles of the central tableland of India were covered with the myrobalan tree, the trade reports published by the Government of India revealed the fact that the Indian market was largely met by Ceylon. A gentleman offered what seemed a probable explanation,—the restrictions imposed by Forest Conservancy,—restrictions which,

TANS; MYROBALANS.

he contended in some instances sacrifice the minor forest products of India in the interests of timber. It was hinted that this state of affairs had two evil effects, *viz.*, it retarded the development of numerous industries throughout the empire, and it was an open question whether the minor products were not, after all, more valuable in themselves than the timber. Two samples of galls found upon the myrobalan trees were placed on the tables. That from **T. Chebula** was stated to be hopeful, but the very plentiful gall from **T. tomentosa**, obtained from the **Reverend A. Campbell**, in Chutia Nagpur, was, after it had been submitted to chemical examination, pronounced valueless.

"A number of other tanning materials were examined, but none seemed to afford sufficient interest to deserve special mention.

"At the close of the examination of tanning materials, the gentlemen adjourned to **Dr. Watt's** office, in order to discuss what action seemed desirable in the interests of the Indian tanning industry.

"It was urged that it was essentially necessary to have the better qualities of tanning materials carefully analysed; and two gentlemen very kindly undertook to do this independently of each other, if they were supplied with samples. They agreed to communicate to the Government the results of their examinations.

"When asked what might be recommended to Government, it was stated that the only thing that could be done was to experiment with the production of extracts or half-stuffs, so as to overcome the heavy charges of transport and freight."

For the Indian use of Myrobalans, see Captain J. Stewart's remarks, *p. 107.*

CHEMICAL EXAMINATION OF MYROBALANS.

One of the gentlemen who promised to furnish analysis of myrobalans—**Dr. B. H. Paul**—has since communicated his results. He took away with him seven samples, one of the fruits or myrobalans of **Terminalia Arjuna**; two of those of **T. belerica**; three of those of the true myrobalan, *viz.*, **T. Chebula**; and one of those of **T. tomentosa.** The following are his results:

No. 1.—**T. Arjuna**	... 1·38	per cent.	of gallotannic acid.	
No. 4.—**T. belerica**	... 5·03	„	„	„
No. 5.— **Ditto**	... 6·70	„	„	„
No. 2.—**T. Chebula**	... 32·82	„	„	„
No. 3.— **Ditto**	... 6·11	„	„	„
No. 6.— **Ditto**	... 26·81	„	„	„
No. 7.—**T. tomentosa**	... 5·97	„	„	„

These results reveal one or two very important points. It would be hopeless in the future to take **T. Arjuna** into consideration as a tanning material. **T. belerica** and **T. tomentosa** are about equal in value; but each contains only one-fifth of the tanning principle of the Chebulic or true myrobalan. (*Compare, however, with the further remarks regarding* **Professor Hummel's** *analysis, p. 89.*) But of the three samples of true myrobalans furnished to **Dr. Paul**, one contained only about the same proportion of gallotannic acid as is usually found in the beleric myrobalan. The writer gave the above samples to **Dr. Paul** personally; and, together with the report, received back one fruit, with its number written on it. The record of despatch of samples agreed with the return; so that no room

TANS; MYROBALANS.

for doubt remained as to the botanical identification being correct. Moreover, those present at the Conference condemned the sample No. 3 as a very inferior quality of the true myrobalan. Others received corresponding samples, and their reports, had they been received, would have been most valuable as placing this matter beyond the possibility of doubt. **Dr. Paul's** analysis, however, of Nos. 2, 3, and 6 so completely confirm the observations and valuations made by the experts present at the Conference, that the theory then advanced regarding the superior quality of the oblong pointed, and solid fruits, as compared with the round inflated ones, will most probably be found correct, *viz.*, that the myrobalans picked off the same individual tree during different stages of their growth will be found to have a varying composition of from 6 to 30 per cent. of gallotannic acid. And this theory is supported by a volume of evidence in the history of all fruits, and particularly by **Professor Hummel's** observation (*see a further paragraph, p. 91, p. 93*), that the tannic principle resides chiefly in the outer pulp of the myrobalan. The transformation from the bitter unripe apple to the ripe, sweetly-flavoured fruit, is so well known as to scarcely require mention. This being so, it would seem desirable to institute a thorough enquiry into the subject of these valuable tanning materials which would have two objects in view—(*a*) to determine the exact age in each locality when the maximum amount of tannic acid was present; and (*b*) the properties and value of the fruits of one district as compared with those of another. In a country with so many different climatic features, and such widely diversified peculiarities of soil as India, it neither follows that the fruits will reach their perfection at the same time, nor that different climates and soils will even, when this point has been determined, produce fruits of equal merit. Were these questions determined, it would be possible for Government to encourage, with reasonable hope of success, the development of a large myrobalan trade; and for merchants to depend upon a good supply of superior fruits. As matters stand, no dependence can be put on the supply or the quality of Indian myrobalans. In the trade a form of the true myrobalan is known as the Jubbulpur myrobalan; and this may literally be grown at Jubbulpur, or may be but a form or condition of maturity first sent to Europe from that district—that quality continuing to bear the name in spite of the fact that it may be obtained from many other localities. So very much superior are these oblong pointed solid and pale green fruits to the large rounded samples, that several of the experts seemed to feel hurt that their belief should be questioned that these were not the fruits of a different species.

As stated above, selections of tanning materials were also furnished to **Professor J. J. Hummel**, Director of the Dyeing Department of the Yorkshire College, Leeds, and to **Dr. Edmund Knecht**, Professor of Chemistry and Dyeing at the Bradford Technical College. **Professor Hummel** has furnished the report below on certain of the tans supplied to him, which, besides giving the analysis of some materials that have not hitherto been subjected to chemical tests, contains many valuable and practical suggestions. In the concluding table of his Report will be found the analysis, together with a comparison in point of composition and price of the Indian tans with four standard tans at present sold in the English market. It will be observed that No. 2 was a sample of **Terminalia Chebula** (similar to that furnished as No. 2 in **Dr. Paul's** set); No. 5 was **T. belerica** which gave the remarkable yield of 17·4 per cent. of tannic acid; and No. 11, **T. tomentosa.** Consignments of most of the myrobalans were received from a great many districts in

TANS; MYROBALANS.

India; and it is strikingly corroborative of what has already been said regarding the necessity of a thorough investigation into the effects of climate, soil, and age of fruit, that, while **Dr. Paul's** sample of **T. belerica** gave only 5·03 per cent., **Professor Hummel's** yielded 17·4 per cent. of tannic acid. On the other hand, the **Professor's** sample of **T. tomentosa** afforded a little less tannic acid than that obtained by **Dr. Paul.** It therefore seems conclusive that **Dr. Paul's** sample of **T. belerica** was either obtained from a district where the species does not produce a good quality of fruit, or that the examples analysed by him were in a different stage of maturity from those examined by the **Professor.** So extremely satisfactory, however, are the results of these chemical tests of the Indian myrobalans, that it is difficult to dismiss the subject. The eminently practical nature of **Professor Hummel's** brief report affords commercial men the means of judging to what extent India might enter into competition with Ceylon and the other countries from which Europe draws its supplies, instead of annually importing large quantities to meet its own market. **Professor Hummel's** remark regarding the prejudices of the tanning trade is important to India. He says: "In making the comparison, the first difficulty met with is that in respect of the tannic matters in use, the price and percentage of tannic acid bear no relationship whatever to each other." The prejudice in favour of certain articles, or for a peculiar colour of a material in opposition to chemical tests, is remarkable. But there is no doubt that this is rapidly disappearing; and when it is known that independent professional opinions have been given regarding an accidental series of consignments of Indian myrobalans, the one yielding 32·8 per cent. and the other 31·0 per cent. as compared with 19·5 per cent. for the myrobalans met with in European trade, an increased demand will set in for Indian tans that will stimulate the investigation indicated in this note and lead to valuable results,—results calculated to benefit the inhabitants of large tracts of this country that now stand greatly in need of some additional source of revenue.

Important Chemical Results.

But we must allow **Professor Hummel's** report to speak for itself: "Herewith I send you the results of the analysis of the various Indian tannin matters, also of some tannin matters at present used here by dyers and tanners, in order that you may have an idea of the value of the former. In making the comparison, the first difficulty met with is that, in respect of the tannin matters in use, the price and the percentage of tannic acid bear no relationship whatever to each other. Why this is so, I am unable satisfactorily to explain; but I imagine that it partly arises from the fact that dyers and tanners do not, as a rule, test their tannin matters, and are frequently guided in their choice by prejudices, and then the price is regulated by the demand and the supply. You will notice, for example, that ground **Sumach** is the most expensive tannin matter; and I believe it is so, not because of its intrinsic merits, but because it is the oldest tannin matter used; and the dyers, being very conservative, cling to its use, and are even willing to pay the higher price demanded to satisfy their whim.* The supply of **Sumach** from the usual sources is limited: the demand through the conservatism of the dyers is large, and so the price is high.

* *Conf. with foot-note, p. 107.*

"If decoctions only were used, the **Divi-divi** would be the cheapest and best tannin matter to use, and **Divi-divi** extract is indeed used in moderate quantity. As a rule, however, dyers and tanners prefer to make their own decoctions with the ground tannin matter, introducing the

textile fabrics or skins into the muddy liquid. For this mode of working the dark outer skin of the **Divi-divi** pod is objectionable, since it attaches itself to the fabric, &c., in minute particles, and causes spots or stains. My results accord entirely with those given in **Crooke's** *Handbook of Dyeing and Calico-printing*, see p. 500.

"Ground Myrobalans are becoming more and more a favorite tannin matter; and since it combines practically every desirable excellence, I recommend you to adopt it as the standard for comparison. You may consider then that the figures in the last column (under the head of Ground Myrobalans) represent the present market values of the various Indian tannin matters. In the case, however, of those whose decoctions possess a deep reddish color, the price would on that account have to be somewhat lower still.

"On examining the list, it becomes evident that the best Indian tannin matters are already in the market, with the exception of **Woodfordia floribunda**; and even this has the drawback of giving deeply colored decoctions.

"Many qualities of **Sumach**, however, are sold in this country, which contain less than 19·5 per cent., *i.e.*, the percentage of the commercial sample examined; I consider therefore that the following Indian tannin matters might probably find a market in Europe:

Woodfordia floribunda (flowers).

Phyllanthus Emblica (leaves).

Terminalia belerica (fruit).

Anogeissus latifolia (leaves).

Diospyros Embryopteris (fruit).

Prospects of a New Indian Trade.

"With reference to the above, I may say that the fruit of **Terminalia belerica** is already sold in this country, and employed as an adulterant of ground Myrobalans (**T. Chebula**). The dried fruit of **Diospyros Embryopteris** is somewhat tough, and consequently difficult, if not impossible, to grind: it could only be used as an extract. The leaves of **Phyllanthus Emblica** and of **Anogeissus latifolia**, carefully dried and possibly ground, ought to find a ready sale, I should think.

"If proper apparatus for extracting the first seven tannin matters on the list were erected in India, I see no reason why a good trade could not be carried on with this country in tanning extracts. This would save the expense of carriage very materially; and Indian labour being cheap, the cost of production would also be somewhat reduced.

"I was somewhat surprised to find the flowers of **Woodfordia floribunda** contain such a large percentage of tannic acid; but it explains why the Hindus use these flowers in connection with alum as a mordant, and with other dye-stuffs, *e.g.*, **Morinda**, as mentioned in the Exhibition Catalogue. It would be interesting to examine the leaves of this plant.

"The remarkable difference in the percentage of tannic acid contained in the inner and outer portions of **Terminalia belerica** is worthy of note. In the fruit of **T. Chebula** I did not observe such a distinction of parts, but I find that on p. 500 of **Crooke's** *Handbook of Dyeing and Calico-printing*,

TANS: MYROBALANS.

it is stated that the stonelike kernel of **T. Chebula** 'contains no tannic acid, which is mainly present in the pulp.'

"The concentration of the tannic acid in the leaves of **Phyllanthus Emblica** while the fruit contains mere traces, is also remarkable. Unless, therefore, the sample of fruit examined has been damaged, or that it is wrongly* labelled, the Hindus make a great mistake in employing it as a tannin matter. From the Exhibition Catalogue I judge they always use it along with some other really useful tannin matter, *e.g.*, myrobalans.

"The utility of **Symplocos racemosa** bark does not depend upon its containing any tannic acid; and I am at a loss to account for its use as a *tan* by the natives of the Central Provinces (see Exhibition Catalogue, p. 156). Its ash contains a large percentage of carbonate of soda; and this may account for the mode of its employment as given, see p. 155, Exhibition Catalogue, under the head of **Rubia sikkimensis**, although I cannot explain the process there given; I fancy some detail has been inadvertently omitted.†

"The barks of **Ceriops Roxburghii** and **Mallotus philippinensis**, seem to be poor tannin matters; and I cannot explain why the former should be described as a *valuable*‡ tan (see p. 151, Exhibition Catalogue).

"I shall be glad to examine such other tannin matters as you may desire to send."

---

* The fruits were correctly labelled; but we have here another proof of the importance of the question of age at which fruits intended as tans should be collected. The fully ripe form of **Phyllanthus** probably contains no tannic acid; at all events, it is a pleasant fruit to eat, and is largely made into preserves. The sample examined by **Professor Hummel** may have been over-ripe. The unripe fruit is intensely bitter.—[*Ed.*]

† The **Professor's** suggestion that the bark is used on account of the soda it contains, and not because of any tanning or dyeing property, is confirmed by the operation described as pursued in Manipur. At p. 155 of the Catalogue it is stated that the bark is burned and the salts contained in the ash extracted; and that it is the liquid thus obtained that is used. I do not think any part of the description has been omitted and the process of dyeing there described was witnessed by the writer.—[*Ed.*]

‡ Mangrove Barks are uniformly so designated by writers on the subject. It would be curious if chemical results disproved popular favour. Probably the Indian Mangrove bark is not so good as that imported into England from other countries.—[*Ed.*]

NOTE.—For **Professor Hummel's** table of analysis, see next page.

Estimation of Tannic Acid in Various Indian Tanning Matters.

Indian Tannin matters.	Percentage of Tannic acid.	Appearance of decoctions.	Money value per cwt. compared with the Tannin materials below, present employed by Dyers & Tanneps.				Remarks.
			Divi-divi.	Valonia cups.	Grd. Sumach.	Grd. Myrobalans.	
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	
1. **Divi-divi** (cultivated in India)	43·5	Pale yellow colour (turbid) ...	0 11 9½	...	...	...	
2. Fruit of **Terminalia Chebula** (Central Provinces).	31·0	Pale yellow colour	...	...	...	0 10 1	
3. Flowers of **Woodfordia floribunda** (Calcutta).	20·6	Deep reddish colour (turbid) ...	0 5 7	0 10 5	0 14 0	0 6 8½	
4. Leaves of **Phyllanthus Emblica** ...	18·0	Pale yellow colour (slightly turbid).	0 4 10½	0 9 1½	0 12 2½	0 5 10¼	4. Appears to contain some essential oil or fat.
5. Fruit of **Terminalia belerica**	17·4	Pale reddish colour (slightly turbid).	...	...	...	0 5 8	5. This fruit consists of two distinct portions (an outer and inner); 100 parts contain 75·4 parts outer portions and 24·6 parts inner. The inner portion only contains 1·25 per cent. Tannic acid.
6. **Anogeissus latifolia** leaves (Ajmere) ...	15·5	Pale yellow colour (slightly turbid).	0 4 2½	0 7 10¼	0 10 6¼	0 5 0½	
7. Fruit of **Diospyros Embryopteris** (Calcutta).	15·0	Pale reddish colour ...	0 4 0¾	0 7 7½	0 10 2½	0 4 10½	
8. Bark of **Ceriops Roxburghiana** ...	9·3	Deep reddish colour (slightly turbid).	0 2 6½	0 4 8½	0 6 3¾	0 3 0¼	
9. **Casuarina equisetifolia**	7·5	Deep reddish colour ...	0 2 0½	0 3 9½	0 5 1	0 2 5½	9. This appears to contain also a red colouring matter, attracted by mordants.
10. Powdered Bark of **Mallotus philippinensis**	6·5	Deep reddish colour ...	0 1 9	0 3 3½	0 4 5	0 2 1¼	
11. Fruit of **Terminalia tomentosa** ...	4·0	Deep reddish colour ...	0 1 1	0 2 0¼	0 2 8½	0 1 3½	
12. Bark of **Minmusops Elengi**	4·0	Pale reddish colour (slightly turbid).	0 1 1	0 2 0¼	0 2 8½	0 1 3½	
13. Fruit of **Phyllanthus Emblica** ...	traces	.....	...	...	...	...	16. This contains 7·4 per cent. ash, which contains 18 per cent. carbonate of soda ($Na_2 Co_3$).
14. **Bassia latifolia** leaves	traces	.....	...	...	...	...	
15. **Baccurea sapida** leaves (Bengal) ...	0	.....	...	...	...	...	
16. Bark of **Symplocos racemosa**... ...	0	.....	...	...	...	...	

The following were examined for the purpose of comparison with the above :

Tans at present employed by Dyers and Tanners.	Percentage of Tannic acid.	Appearance of decoction.	Value per cwt. ; December 1886.
			s. d.
Divi-divi	44·25	Pale reddish colour (turbid) ...	12 0 = 3·25 pence per 1 % Tannic acid per cwt.
Valonia cups	31·25	Pale yellow colour ...	16 0 = 6·14 ditto ditto ditto.
Ground Myrobalans	33·0	Pale yellow colour (turbid) ...	7 6 = 3·91 ditto ditto ditto.
Ground Sumach	19·5	Pale yellow colour (slightly turbid).	13 3 = 8·15 ditto ditto ditto.

(Sd.) J. J. HUMMEL,
Yorkshire College, Leeds.

TANS.

TANS FROM MYROBALANS.

A FUTURE FOR TANNING LEAVES.

It is scarcely necessary to comment further on **Professor Hummel's** remarks regarding the tans with which his report deals. He alludes, however, to one or two, with regard to which special mention has not as yet been made, and he furnishes besides interesting supplementary facts regarding some of those briefly discussed in the early paragraphs of this pamphlet. His opinion, that there seems likely to be a future for the leaves of **Phyllanthus Emblica** and **Anogeissus latifolia,** will be read with much interest. These trees abound throughout the drier tracts of the great central tableland of India—a region inhabited by the very poorest of her people. It remains therefore to ascertain the season at which these leaves possess their maximum amount of tannic acid. Should this correspond with the period of leaf-shedding—a period when miles of country become often literally strewed with them—an indefinite quantity might be collected, affording thereby both fuel to boil the liquid with, and material from which to prepare the decoction. But it is necessary to determine not only the period of the greatest yield, but also whether an extract could or could not be profitably prepared, or whether a dried powder of the leaves would not be preferable. In the same region where **Phyllanthus** and **Anogeissus** abound, **Terminalia tomentosa** (the *Asna*) and **Shorea robusta** (the *sál*) are also plentiful. Incidentally allusion has already been made to the last two trees, and the tans obtained from them shall be reverted to later on; but it might be suggested in passing that as the four above-mentioned trees are rich in tanning matter, it would be worth while to ascertain whether an accidental or previously determined definite mixture of the leaves, fruits, and barks of all four, would not afford a useful tanning principle. (Conf. with Mr. Rebsch's preparation of Sál extract on page 96.)

THE WOODFORDIA.

It is next to impossible to avoid the conviction that very little skill would be necessary to take a mixture of all the tanning materials mentioned above, and after having extracted their active tanning principles, to free the half-stuff thus obtained, largely if not entirely, of any objectionable colouring agents; nay, even to prepare on the spot chemically pure materials. At all events, it would seem desirable to ascertain if it would pay to extract a crude tannin from any one, or from a mixture of some of the four materials mentioned above. But to these might be added a fifth, *viz.*, **Woodfordia floribunda.** By the addition of that handsome shrub to the list of trees already enumerated, a characteristic feature is obtained of the vegetation of an immense portion of the jungle or open forest tracts of India. Indeed, the whole of that region might with much truth be called the tannin-yielding forests of India; for, while the myrobalans are not so plentiful there, as the above mentioned plants, their habitats are interspersed with the *mahua* (**Bassia latifolia**) and the wild mango (**Mangifera indica**). This leads naturally to the consideration of the two trees of the series with which **Captain Wood** has been experimenting, *viz.*, the *sál* (**Shorea robusta**) and the *Asna* or *asaina* (**Terminalia tomentosa**). Enough has been said, however, as to the region over which these trees occur. Suffice it to add that the *sál* is one of the most abundant and at the same time one of the most valuable trees which frequent the subtropical forest tracts of India. It occurs in the mixed forests of the Sub-Himálayan belt from the Beas river in the Panjáb to Assam; is met with also in the eastern part of Central India, and on the central tableland from the Ganges to the Godaveri, and extends westward to the longitude of Mandla, with an outlying patch on and around the sandstone hills of the Pachmari Range. But there are

THE AL.

four or five other species of the same genus which are believed to be similar in the character of their barks, and hence for tanning purposes these may be included with **S. robusta**, thus extending, by means of **S. obtusa** and **S. Siamensis** the area of distribution from Assam through Manipur to Burma; and by means of **S. Talura** and **S. Tumbuggaia** from the central tableland of India to Mysore and Madras. Should, therefore, a prepared extract from **Shorea** bark prove of value to the tanner and obtain a remunerative price, there would practically be no limit to the supply. The timber afforded by these trees is one of the most extensively used woods in India; and it would, indeed, be hard to form even an approximate estimate of the number of trees annually thrown down, for railway sleepers, and other such purposes, or of the amount of bark periodically wasted. These facts may be accepted as strengthening **Captain Wood's** contentions, which are more or less of a local and accidental nature, *viz.*, that railway extension is causing immense numbers of trees to be felled, the barks of which are at present put to no useful purpose whatsoever.

TANS; THE SAL.

SAL AND ASAINA TANS.

EXTRACTS from SAL.

No. $\frac{M}{286}$, dated Gola. L. S. Railway, the 28th January 1888.

From—CAPTAIN E. S. WOOD, Conservator of Forests, North-Western Provinces and Oudh, Oudh Circle,

To—The Inspector General of Forests to the Government of India, Calcutta.

On receipt of your Proceedings for the month of October 1887,* I noticed that some correspondence regarding tanning materials had taken place between yourself, **Messrs. Cooper, Allen & Co.** and **Mr. Whittall,** then officiating for me. The utilization of the bark of our Sál and Asaina coppice, which will now be cut over by the thousand acres annually owing to the entrance of railways into the forest, is, I consider, a point of vital importance to the interests of the Forest Department. **Mr. Rebsch,** under my direction, made some practical experiments in the manufacture of Sál and Asaina bark extract; and before I left for England I was working for the introduction of the dried essence of Sál bark into the market, having sent some to the Harness Factory, Cawnpore, to **Dr. Warth** for analysis, to the Edinburgh and London Exhibitions, and to the analysers of tannic matters for the trade journal called *Leather*. I have referred to the matter in one or more of my annual reports and papers on fuel, &c.

* Received 25th January 1888.

and

No. $\frac{M}{288}$, dated Gola. L. S. Railway, the 28th January 1888.

ASAINA.

From—CAPTAIN E. S. WOOD, Conservator of Forests, North-Western Provinces and Oudh, Oudh Circle,

To—Messrs. Cooper, Allen & Co., Cawnpore.

GENTLEMEN,—My attention was called the day before yesterday, in the Proceedings of the Inspector General of Forests, to some correspondence regarding the tannic properties of the barks of forest trees which at the time led to no results.

Before I went on furlough in August 1886, returning in the end of November 1887, and before knowing the use of Hemlock bark as a tanning agent in America and Europe, I thought of making an extract of Sál bark,

TANS FROM SAL AND ASAINA BARKS.

with a view to see if it could be utilized in the leather trade, the distance from the forests prohibiting the sending the raw material to the ports of Bombay and Calcutta. **Mr. Rebsch** accordingly, under my instructions, prepared some extract, the first year in a liquid state, and in the second year in a dried state; and it was these experiments that you evidently heard of. The process used, first, was the very rough one of cutting the bark in small pieces and bark chips in exactly the same method as Catechu is obtained from the chips of the heart wood of the tree called **Acacia Catechu.**

I send you copies of the letters received from the Superintendent, Harness Factory, Cawnpore, from **Dr. Warth,** Dehra Forest School, from **Mr. W. N. Evans,** Tanner, London, and **Mr. Rebsch's** report of the manufacture, which was only an experiment, and which could doubtless be improved on as regards economy of working and as regards the extractive coloring matter, which seems to be against the value of the extract.

I have ordered **Baboo Karun Nidhan Mukerji,** Sub-Assistant Conservator of Forests, Gonda Division, camp *viâ* Mankapur Gonda, to send you two *gharras*-full of extract made about two years ago—one hard, the other soft; but whether of Sál or Asaina I cannot tell just now.

I have also desired **Mr. Ponsonby,** Deputy Conservator of Forests, Bhira, Sub-division of Kheri, camp *viâ* Gola Gokarnath, to send a maund of green Sál bark freshly taken off the trees, and the same of green Asaina bark, all free of expense, so that you can ascertain the value of the same.

Owing to the approach of the Bengal and North-Western Railway and the Lucknow-Sitapur Railway to the forests, it is possible that bark properly dried will be able to be sent with profit to the Cawnpore market. If so, the Oudh Forests will be able to produce more bark than the whole of the Cawnpore tanneries can consume, and also for the manufacture of essence in the forest, to people who choose to take up the manufacture for European market.

No. 26-C., dated the 20th May 1886.

From—B. A. REBSCH, Esq., Assistant Conservator of Forests, in charge, Gonda Division, Oudh Circle,

To—The Conservator of Forests, North-Western Provinces and Oudh, Oudh Circle.

I have the honour to enclose herewith a detailed report on the preparation of *Sál* and *Asna* bark extract as a tanning agent.

With regard to the cost of preparation, I would beg to submit to your notice that we have had great difficulty in inducing men to make the extract; and I have no doubt that if the material succeeds (as it undoubtedly will), that its manufacture on a large scale will become less expensive as people get more accustomed to the work.

MANUFACTURE OF SÁL BARK EXTRACT.

The manufacture of Sál bark extract is carried on in a way similar to that practised by the Catechu makers in the Gonda forests.

The first requisite is the choice of site where the boiling is to be carried on. The place must be near an abundant supply of water, and also within easy reach of the bark, which is to be boiled down. The site for the encampment being chosen, and huts for the men built, the building of the

furnaces is begun. The furnace is built of clay, the walls being about 6″ thick and from 10 to 15 feet in length; the inner breadth is about 2′ 6″, and the height is about the same. The top of the furnace is arched, holes being left along the length of the furnace on the top and on both sides to hold the earthen pots in which the bark is boiled. There is also a fire hole at each end, and at one of the sides through which fuel is introduced and ashes, &c., raked out.

When the furnace is built, the work of collecting and chipping up the bark is begun. The bark is usually stripped off logs in pieces 3 feet long; these pieces are collected and brought in bullock carts to the encampment, and cut into small pieces about 3″ × 4″.

These chips are then put into earthen pots (*handis*), so as to half fill each pot; and water is poured in till the pot is three-quarters full. The pots thus filled are put on the furnace to boil. After the liquor has begun to boil, it is allowed to simmer for about an hour and a half till the liquor is of a very deep red colour. It is then strained into a fresh pot, the boiled chips being thrown aside and spread out to dry, when they are used as fuel for feeding the furnace. I found that the liquor from 3 pots of the first boiling is sufficient to fill a pot for the further boiling process, so that if a furnace holds 21 pots altogether, the liquor obtained after the chips have been boiled and strained would fill 7 pots; the pots containing the strained liquor are generally placed in the centre line, while the remaining 14 pots are again filled with chips and put on the sides of the furnace.

The strained liquor is boiled for an hour, and by that time is reduced to about one-half its former quantity, so that half the pots are free to take the fresh outturn from the 14 pots containing chips. In about another hour the liquor becomes gradually stiff; and great care must now be taken not to allow it to burn; and as soon as it attains the consistency of treacle, it is removed from the fire and poured into a wooden trough.

When the trough has been filled, the contents are allowed to cool during the night, and next morning are poured into a pit, which has been previously prepared.

The pit is circular in shape, with a diameter of 3 feet and a depth of about three feet.

Each day's outturn is poured into this pit the next morning; and this is continued till the pit is filled, when a fresh pit has to be dug.

The furnace which I used in Ramgarh held 21 pots. The boiling was done by three Khairaha women, wages 2½ annas each per diem; and the average daily outturn was 16 seers of the extract. One coolie (on two annas per diem) was employed at the furnace for cutting up the bark, &c., two men for cutting poles and stripping off the bark, one man for cutting fuel, and a bullock cart for carrying fuel and bark to the furnace.

I will now give the results of the process for a period of 58 days (*viz.*, from 2nd February 1886, to 31st March 1886). During this time (58 days) 291 maunds of sál bark were boiled, and yielded 67 *ghurras* of the extract. The average weight of a *ghurra*-full of extract was found to be 14 seers; and the total weight of extract obtained 23 maunds and 18 seers.

The total expenditure was Rs. 102-4-0. It will be seen from the above figures that one maund of sál bark yielded 3·22 seers of the extract. It will perhaps be interesting to compare these figures with the results obtained during the manufacture of Asna bark extract.

TANS. ASNA BARK EXTRACT.

MANUFACTURE OF ASNA EXTRACT.

I begun the Asna bark boiling at Sungarha on the 11th January 1886; and the figures given below are the results of the process from that date to the 31st March 1886 (*viz.*, 79 days). 184 maunds of Asna bark were boiled, and yielded 42 *ghurras* of the extract. The weight of a *ghurra*-full of extract was found to be 13¼ seers, so that the total outturn of extract was 13 maunds 36½ seers. The expenditure amounted to Rs. 77-5-5.

When comparing the results obtained from the two kinds of bark boiled, ample allowance must be made for the fact that the sál bark used at Ramgarh was taken from young and suppressed poles, while the asna bark was taken from mature and decaying trees. This will at once account for the fact that in the latter case a smaller quantity of extract was obtained per maund of bark than in the case of sál. The most striking point, however, is that sál bark extract is heavier than an equal quantity of asna bark extract; one *ghurra*-full of sál bark extract weighing 14 seers, while the same quantity of asna bark extract weighed only 13¼ seers.

The boiling has been continued both at Ramgarh and Sungarha; but I am not able at present to give the results, as the details are incomplete. But an extremely interesting fact has been observed, which is worth recording—namely, that after the 31st March the amount of sál extract obtained per maund of bark has increased, while in the case of asna it has become less.

Dated 5th June 1886.

Demi-official from—W. N. EVANS, Esq., Editor, "*Leather*,"

To—The Conservator of Forests, Oudh Circle.

CHEMICAL ANALYSIS, SAL EXTRACT.

I received from **Messrs. Rider & Co.**, Publishers of the *Timber Trade Journal*, a sample of "Sál" Bark Extract, with a request to analyze it, and state how far it is suitable for tanning. I now give the copy of analysis:

Specific Gravity	...	...	= 1·333=36 degrees Bamin.
Moisture	...	...	= 7·33%
Reduced to ashes	...	...	= 0·392%
Tannin	...	...	=32·29%
Non-Tannin other acids		...	= 3·93%

This account differs from the copy sent to **Messrs. Rider & Co.**, as the *moisture and ashes were wrong*.

The color of the solution made by the extract will be rather against its sale, but otherwise, judging from its strength, as about equivalent to chesnut wood extract of 30 degrees Bamin, which is selling from £12 to £15 per ton.

No certainty can, however, be given to its real commercial value until it has been tested in some tannery, the quality of the leather it produces and the cost being the principal items involved. Shall be pleased at any time to analyze any new material you may send, charging you just the expenses, which amount to 7*s.* 6*d.*

Any information as to growth of these different tanning agents you may feel disposed to give will be thankfully received for the information of the readers of *Leather*.

TANS: EXPERIMENTS with SAL EXTRACT.

Extract from Report of the FOREMAN, Cawnpore Harness and Saddlery Factory.

The concentrated essence of Sál Bark received has been tested and tried as far as practicable with the quantity received.

The amount received, *viz.*, 1½ oz., was tried up to 21 ozs. of water, or 14 times its own weight; and a rich brown liquor of 24° was the result. The quantity received was so very small, that its tanning properties could not be fairly tested; but judging from appearance and taste, I think it will be worth while to try it. It would be much better if it could be made solid, instead of a liquid, as by doing this there is not so much fear of evaporation, which will cause the extract to vary in strength.

No. 2477, dated 16th October 1883.

Memo. from—COLONEL R. A. J. STEWART, Superintendent, Cawnpore Harness and Saddlery Factory,

To—The Conservator of Forests, Oudh Circle.

In forwarding the above, in reply to his No. 199-M. of 18th September 1883, the undersigned has the honor to state that the liquor obtained from the extract of sál bark registered 24° of the barkometer; and it is probable that if a larger quantity had been sent, a tougher infusion could have been made.

The undersigned has not the means to test the extract chemically to discover the exact amount of tannins, and cannot make a practical test of such a small quantity; but he is of opinion that the extract would give good results as a tanning agent, and it would be worth while to have sufficient extract to tan a given number of hides. Would it be possible to obtain 5 cwt. of this extract?. A small sample of English log-wood extract is herewith sent to show you to what consistency the sál-wood essence would be advantageous.

Dated 7th November 1883.

From— Dr. H. WARTH, Professor of Natural Sciences, Central Forest School, Dehra Dun,

To—The Conservator of Forests, Oudh Circle.

In reply to your No. 199-M. of the 27th September, I have the honour to state that the sál bark extract has been analysed in the chemical laboratory of the Central Forest School, with the aid of **Messrs. Copeland and Blanchfield.**

The result is:

Sál bark extract in a semi-fluid state:

Water	11·23	per cent.
Insoluble in—		
Water	5·86	,,
Tannin	16·73	,,
Balance soluble—		
In water	66·18	,,
Total ...	100·00	,,

Of the whole ... ... 7·79 per cent. ashes were left.

TANS; CHEMICAL ANALYSIS, SAL EXTRACT.

The color of the iron precipitate is dingy green. The tannin is therefore of the same kind as that which is contained in **Acacia Catechu** extract. The tannin of gall apples, galla tannin, gives a bluish black precipitate with iron, and is therefore different.

There was no Catechu acid present.

For comparison I give you herewith the analysis of good genuine Burmese (Rangoon) cutch, which **Mr. Ribbentrop** sent me in January 1882:

CUTCH, RANGOON.

Catechu acid	0·0	per cent.
Catechu—tannic acid	7·35	„
Insoluble in water	14·35	„
Soluble in water	78·30	„
Total ...	100·00	„
Ashes in the whole	18·89	„

The method of analysis was the same in both cases—namely, precipitation with gelatine.

Important Result.

Your extract is thus apparently twice as good as Burmese cutch. It would be of scientific interest to know how much bark was used in the preparation of the extract. Would you desire a publication of the results in the *Forester*, accompanied by a description to **Mr. Fisher**, the Editor? I would gladly make any suggestion I could on the possible improvement of the manufacture, if you would kindly let it be known how the extract has hitherto been made.

DIVI-DIVI PODS.

(Conf. with Dictionary Economic Products, Vol., II., 6.)

Divi-Divi.—In the second volume of the *Dictionary of Economic Products of India* will be found a brief account of **Divi-Divi** pods (or American **Sumach**) under the botanical name of the plant **Cæsalpinia coriaria** (C. No. 20). In that article there occurs the following remark: "Recently a large experimental consignment of the pods has been sent to the Secretary of State for India by the Bombay Government. This consignment was accidentally seen by the writer while in London; and it is likely that a highly favourable report will be furnished." This forecast has been more than fulfilled, as may be seen from the following papers, which have been since published.

Extract from the Proceedings of the Government of Bombay, dated 30th August 1887.

Read the following:

Despatch from Her Majesty's Secretary of State for India, No. 13 Revenue, dated 14th July 1887.

"In continuation of my despatch No. 3 (Statistics and Commerce) of the 20th January last, I forward herewith copies of the reports I have received from the brokers and others to whom samples of the **Divi-Divi** pods forwarded by your Government were submitted for valuation.

TANS; DIVI-DIVI.

"2. The bulk of the consignment (17 bags) of pods was sold to **Messrs. Martin and Millar** of Glasgow for £13-8-1, being at the rate of £8 per ton; and this amount has been credited in the Schedule of Receipts in the Account Current with Bombay for April last."

Letter from the Under-Secretary to the Government of India, Revenue and Agricultural Department (*Agriculture*), No. 653—36-6A., dated 15th August 1887.

"I am directed to enquire whether the Government of Bombay proposes to print and circulate among Agricultural Departments and the Public Press the reports forwarded by the Secretary of State with his despatch No. 13 Revenue of the 14th ultimo, on the samples of **Divi-Divi** sent for valuation from the Bombay Presidency."

RESOLUTION.—Copies of the despatch and accompaniments should be forwarded to all Commissioners, Collectors, Conservators of Forests, the Director of Agriculture, the Superintendent of the Government Experimental Farm at Bhadgaon in Khandesh, and the Chambers of Commerce at Bombay and Karachi, as well as to the Agricultural Departments, &c., mentioned in the distribution list of Agricultural Reports circulated by the Government of India.

2. The despatch and its accompaniments should be published in the *Government Gazette*, and copies placed on the Editors' tables.

3. The Government of India should be informed of the issue of these orders, with reference to their letter No. 653—36-6A., dated the 15th instant.

No. 5762, dated Bombay-Castle, 30th August 1887.

NOTIFICATION—*By the Government of Bombay, Revenue Department.*

The following Despatch [*given above.*—(*Ed.*)] from Her Majesty's Secretary of State for India, No. 13 Revenue, dated 14th July 1887, and the reports received therewith on certain samples of the pods of the **Divi-Divi** tree (**Cæsalpinia coriaria**) sent from Bombay in October 1886, are published for general information:

Dated Bristol, 21st February 1887.

From—MESSRS. P. & S. EVANS & Co.,

To—The Under-Secretary of State for India.

Referring to our conversation on Friday last, respecting the sample of Bombay **Divi-Divi** sent for our opinion by **Sir G. Birdwood,** we think it a very fine sample, well grown and of good colour and strength, being 9 per cent. stronger than ordinary qualities, and, speaking generally, would rank at to-day's prices at Bombay £10 per ton, Savinilla £9, Curacoa £9-10-0, Rio Hache £8-10-0 or £8. Valuation.

This article may become a very important agent in tanning if the difficulty of using it can be overcome. At present, if used plentifully, it is liable in thunder weather to change the colour of the liquors to a purple

A6017

TANS; DIVI-DIVI.

colour, and cause spots on the leather in the pits, occasioning a loss in large tanneries of hundreds of pounds in a single night. Another peculiarity is, that the leather made by its use feels firm in dry weather and soft in damp days: hence the trade generally use very little of it, though it is supposed to make otherwise a profitable leather, and tanners will be glad to have the opinion of chemical experts in India or elsewhere who can suggest a remedy.

Suggestion regarding MIMOSA BARK.

Whilst writing, we should like to suggest the introduction of the **Mimosa** tree and its cultivation in India as a means of supplying the bark to tanners, both there and in England. The best sort of bark in Australia is procured from the **Acacia pycnantha** [Conf. with remarks at page 85.—(*Ed.*)] and is easily raised from seed,—30,000 seeds weighing 1 lb. sown broadcast on loose sandy soil, 10,000 seeds being enough for an acre of land: the young plants grow freely, and can be cut for bark after 5½ years' growth. A report published in 1878 by the Board of Enquiry and sold by **G. Robertson**, Little Collins St., Melbourne, will supply all necessary details.

At present, owing to the immense and chief supply of the red bark used by American and Canadian tanneries, the English manufactures are run hard; but the growth of the **Mimosa** in India would soon spread and be a source of wealth to that empire, as well as a considerable help to English tanners.

Dated 25th March 1887.

From—THOS. PALMER, Esq., B.Sc., Grange Mills, Bermondsey, London,

To—The Under-Secretary of State for India.

I must ask you to accept my apologies for having taken so long over the sample of **Divi-Divi** you were good enough to honour me with; but I have had my hands so full of work, that I have been unable to give it the attention it deserved.

The sample submitted to me is clean and bright, but contains some scorched pods. There is a larger proportion of fibre than in the West Indian sorts; though it resembles that from Rio Hache more than that from Savanilla. I should consider it worth about 30 shillings to £2 a ton less value than this latter. The extract produced is darker; but the difference in strength is but small. However, as the material is most employed for imparting bloom to leather, the mere colour is of importance. I am of opinion that it would be a suitable substance for the tannage of Hysole leather where mixed tannages are used; and think there would be a market for it, especially as at present time there is a large demand for the best qualities of West Indian at late prices; and there are no sellers but at considerable advance, the growers complaining that late prices are not remunerative enough to enable them to collect the crop.

The majority of the material is used in the Midlands. I note that the prices quoted for the best qualities are from £11 to £12 per ton.

Dated 13th May 1887.

From—MESSRS. MARTIN & MILLAR, 847, Duke Street, Glasgow,

To—The Under-Secretary of State for India.

Referring to yours of the 5th instant, the Bombay **Divi-Divi** from the India Office is of excellent quality, and contains about 5 per cent. more

tanning than good average, Mar-cai D, or Venezuela **Divi.** We only wish you could encourage the production of it in quantity.

No. 106, Snowfields, Bermondsey, dated 20th May 1887.

Demi-official from—R. W. SPICER, Esq., Editor, "*Leather*,"

To—The Under-Secretary of State for India.

Replying to yours of the 5th instant, the **Divi-Divi** is a very fair quality, and its present value is from 10·6 to 11 shillings per cwt. For information as to its use in tanning, and its properties as tanning agent, I beg to refer to the June number of "*Leather*," a copy of which shall be sent you, and which will contain an article on the subject.*

* See extract below.

I shall be glad to know from whence this sample is obtained, and whether there is likely to be any considerable quantity produced.

I regret very much that a report was not sent to you in due course, but the matter had been left for the attention of an analyst, Mr. W. L. Evans, who has been seriously unwell during the last three months.

Extract from "*Leather*."

Divi.—"The use of this valuable product has remained almost stationary during the past quarter of a century; and the reasons for this apparent neglect are not far to seek. In the first place, it is somewhat uncertain in its arrivals. The London market, for example, has been quite devoid of stocks during the past few months; and tanners in that district, who were arranging to use it, may have been somewhat disconcerted by the impossibility of securing needful supplies. The very few manufacturers who use it regularly, as a rule, carry a heavy stock in hand—sometimes as much as would carry them through twelve months of ordinary work. This plan could only be followed by men to whom the temporary lock-up of £2,000 to £3,000 is a matter of small moment. A still more fatal objection to its more extensive use is its erratic effect upon the colour and quality of the leather submitted to it. The same shipment has been known to impart a delightfully light and even colour to one pack of butts, whilst another pack subjected to precisely the same conditions has come out dark and spotted. Many theories are advanced to account for these differences. It is certain that fermentation rapidly affects **Divi**, and brings with it many disastrous changes. This point will shortly be the subject of keen enquiry by our scientific tanners; for almost all tanning agents are affected by it in a greater or less degree, and the question of profit or loss may hang upon the utilisation of strong liquors. Some antiseptic would probably be helpful to a tanner using **Divi**. The water in some yards seems to favour its use. We can remember a yard in Somerset where during the past thirty years an immense proportion of **Divi** has been worked with impunity; whilst, on the other hand, we can remember neighbouring yards where, after a very short trial, the tanner has dropped its use a sadder and a poorer man.

"Each man advocates a different method of using it; and no doubt some merit attaches to each. A favourite plan is to place the proportion used in the middle of the leach, so that air and light are excluded by the

TANS; DIVI-DIVI.

layer of top material, whilst the **Divi** liquor has the further advantage of filtration through some light-coloured material at the bottom. It may be helpful to do this; but we think, if fermentation is going to take place, such precautions are of little or no use, and that the following idea, which we have seen successfully applied, might be useful. Boil your **Divi** with liquor or water as the case may be, adding a very little 'anti-galline'; and add the cooled liquor to either leather in pits, or leaches which need it. About three boilings reduce the **Divi** to pulp, and the exhaustion of tannin is complete: time is saved, and fermentation delayed.

"Anybody devising some safe and general method of use would deserve well of his trade; for its comparative high percentage of available tannin makes it a cheap ally. It is somewhat remarkable for its weight-giving properties, and it often affects leather, which has been treated to a large proportion of it, by being subjected to the influence of the weather; and on a bright clear day handling hard and firm, but on a wet day the same bale of butts will handle soft and flabby. The question of weight is important in these days of low prices; but customers object to a dirty loaded flesh, and **Divi**, unfortunately, adds a good deal of sediment to the flesh which is not leather: and although the West of England tanners are able to persuade their customers to take it, when it comes to be damped a good deal comes away and causes dissatisfaction. A gummy substance in **Divi** is, we think, largely absorbed by leather and adds to its weight; but this gum is not of so waterproofing a nature as the resinous matter which Hemlock contains; and we think leather made from the latter is of much better quality, and would repel water at least twice as long. The requirements of the trade may demand light-coloured leather; and many devices are resorted to by which colour at the expense of quality are gained, and **Divi** must be imported more steadily and regularly, if we are to adopt it more largely. Any chemist showing a certain cure for its bad colour would do well for himself."

CONCLUDING REMARKS.

The various special reports given above seem to indicate that India possesses many highly valuable tans. Accepting **Professor Hummel's** view of the conservative character of the tanning trade, all that would appear necessary therefore to secure for India a greatly extended share in the world's supply would be a combined effort to overcome the prejudice against changing from an established to a new source of supply for well-known tans. The **Acacia** barks obtained from Australia appear to be in greater demand than those from India, and not proportionately so to any established superiority. There are practical objections to **Divi-divi** (*see the passage reproduced from "Leather"*), but the pods now grown in India, from a chemical point of view, are at least quite as good as those from any other part of the world. But, in spite of all these facts, it seems highly probable that a new tanning material such as the extract or powder recommended above (*see pp. 84, 85, 86, 87, 91, 94, 95, &c.,*) would be more likely to meet with a rapid success than all the efforts that could be put forth to display the merits of Indian tans that are already obtained from other countries.

SIMLA;
August 1888.

GEORGE WATT,
Reporter on Economic Products.

TANS.

TANNING AND CURRYING AS PRACTISED IN INDIA.

The following correspondence and historic sketch of Tanning as practised at the Government Factory at Cawnpore will be read with interest, as it supplements largely the opinion already given regarding the merits of certain Indian Tans :

No. 1446, dated 19th July 1888.

From—The Superintendent, Harness and Saddlery Factory, Cawnpore,

To—The Reporter on Economic Products.

Under instructions from the Government of India, I have the honour to send you herewith notes on the subject of hides, and the system under which tanned and curried. These notes have been extracted from "Selections from the Records of Government, North-Western Provinces, Second Series, Vol. III., 1870," which I have corrected up to date.

Notes by CAPTAIN JOHN STEWART, R.A., Commissary of Ordnance, in charge of Government Tannery, Cawnpore.

Process of Tanning and Currying leather at the Cawnpore Government Tannery.

Buildings. The tannery. Lime pits. Bark taps. Spenders. Tan pits.

"The tannery consists of a large building, in the floor of which are masonry pits plastered with chunam. The floor is on two levels. The lower contains the beam-house and lime-pits, where the hair and flesh of hides are removed by the action of milk of lime ; also the bark-taps and "spenders" where the bark is infused. The latter are large masonry pits, with false bottoms of wood, through which the infusion drains off by plug-holes into a well adjoining, where a pump is fixed, and the liquors are raised and carried into the tan-pits on the higher level ; these are the pits in which the hides are "tanned" and they drain off into the spenders and taps on the lower level.

The Currier's shop.

The Currier's shop is a long two-storied building : the lower story is furnished with Currier's beams, and scouring tables of stone, where the hides are "shaved" and scoured preparatory to being oiled and "dubbed." The upper story is for finishing the "currying" process. It is furnished with wooden tables for setting out and "dubbing" the hides, which are hung up to dry on battens suspended from the roof. There are arrangements for hanging the hides on both stories.

HIDES.

Raw material.

The hides and skins tanned and curried are—buffalo, bullock and cow, and goat and sheepskin.

Buffalo Hides.

BUFFALO HIDES are obtained from the slaughter markets of Cawnpore and adjacent towns and cities. They are either green, direct from the butcher or dry salted. They are best suited for tanning in the former condition as the salt cure of the North-Western Provinces is inferior and imperfect, absorbing so much moisture that in the damp heat hides are apt to rot ; while the dry heat of the climate so hardens and contracts the fibres of the skin that much labour is required to loosen the pores to receive the lime and tan. Great precaution, therefore, is necessary in the selection of dry salted hides, especially as native dealers lay on the *kharee* or salt very thick to gain weight. If the hides are fresh slaughtered and have been lightly cured, they soak down to a natural state in about two days, but if they are stale, that is, have been cured some months and are besmeared with *kharee*, the tanner should reject them, for they will very likely decompose in the soak before becoming soft. Buffalo is the only available hide that will produce leather thick enough for harness work in this country, but there is no doubt that much of the inferiority of country leather arises from the poorness

TANNING.

of the skin of that beast. It is poorly fed, not generally cared for, and usually killed when too old to breed or give milk.

The hide of the male buffalo is too coarse, and it gets such bad treatment in the plough or the cart that it is generally full of sores and goad marks. In large towns there is a market for buffalo beef for the low caste and poorer Mussalman population, and also for grease, but the younger and better cattle are rarely slaughtered; it is from these that the local tanners select their hides for the finer uses of harness, saddlery and accoutrements. Many good hides are ruined by the butchers in "flaying," from inefficient arrangements in the slaughter houses and from injudicious use of their tools.

Bullock and Cow Hides.

Bullock and Cow Hides are also procured green and dry salted, but the same care is necessary in selection. The animals slaughtered by the Commissariat Department are usually the best, but they are small and unfit for any thick work. This class of hides is much exported to England, and extensively used there for boot and shoe upper leather, for which it is much esteemed. In the English market there is great objection to North-West cured hides. Patna, Dacca and Durbungah cures, though the hides are not in themselves superior, are far preferred. The finest hides of this description are those killed at Agra, Delhi, and Meerut. Much damage is done to the hides by branding on the butts and shoulders.

Goat and Sheep Skins.

Goat and Sheep Skins are always obtained green from the local market; skins are generally very good; sheep are poor and small.

MATERIALS USED IN TANNING, &c.

White or stone lime.

Lime is brought into Cawnpore, chiefly from Banda District, and is used for loosening the hair and flesh of hides and killing the grease. It should be taken in lump, unslaked. This is now being experimented on by the use of carbonic acid gas.

Bran.
Tanning agents.
Babul Bark.

Babul bark is obtained locally, the wood being extensively used for firing. The bark season extends from January to June, that is, the spring of the year, when the sap is upon the trees; from six to ten year old trees are the best for bark. The bark should be peeled from the trees immediately after they are cut down. The natives are rather careless in this particular, and greatly injure the bark, for, to get it separated from the wood, they beat it with wooden mallets, and gash it about to get it loose; they then peel it off by hand; each gash is a wound in the bark through which the tannin escapes. In England a peeling iron is used, and long strips of bark are taken off without any beating, but of course this must be done before the sap has dried. The tannin is contained in the white or inner stratum of the bark. The tannin is stronger in babul than in oak bark, but the quality is not considered so good.

Conf. with pp. 84-85.

Experiments tried lately in England by **Professor Abel**, the Chemist to the War Department, proved *babul* to have keeping qualities quite equal to oak bark, if not superior; it is thus a valuable tanning agent. But it has more colouring matter, that is, it gives a reddish liquor, and this is somewhat against it, but a great advantage is found from mixing with it, *hurr*, or *bahaira* (the myrobalan of commerce—the dried fruit of **Terminalia Chebula**), which is plentiful in the market, and is used extensively as a dye. The liquor from the *hurr*, or *hurra*, is a powerful tan, and though it is not reported to be of a quality that would make good leather of itself, it is highly esteemed in England to mix with other tanning agents, owing to the bright colour it imparts, and herein is its usefulness in combination with *babul*. The *hurr* is a product of the forest, and is very common, but the natives of Cawnpore use it only as a dye. **Sumach** is another tanning substance, which has been used in small quantities at this tannery, but only for

Myrobalan.
(Conf. with pp. 87 to 93.)

Sumach.

A Note prepared by the Officer in charge of the Cawnpore Tannery.

finishing and imparting colour. It is imported from England and is therefore very expensive.*

TANNING.

Cutch is a very powerful astringent and rich in tannin. It is the inspissated juice of **Acacia Catechu** (the *khair* of the forests), and is used by the natives as a dye and is also eaten with *pán;* its tannin is three or four times stronger than that of oak, but of poor quality; the leather made of it is of dark colour and does not last well, but tans so quickly and therefore so cheaply, that it is used extensively in England: such leather is believed to be unsuited for wear in this climate. At Cawnpore the Cutch is employed only for darkening colour when that is required.

Terra Japonica or Kutch.
(Conf. with p. 81.)

Divi-Divi is the pod of a shrub that is a native of South America, but grows well in the Madras and Bombay Presidencies; it is called the **Cœsalpinia coriaria**. The pod is exported from Bombay to England, but in small quantities. The tannin is strong and considered good for mixing with barks. The shrubs were grown at Cawnpore from seed and a plantation of about 6,000 or 7,000 trees is doing well. The barks of *Sál*, *Asaina* and *Amultas* are known to contain tannin, and experiments are being carried out with them.

Divi-Divi.
(Conf. with pp. 90, 93 and 100 to 104.)
Other tanning barks.
Conf. with pp. 94 to 100.

The only oil used for currying is cod-oil; it is obtained from England, and is the best known for the purpose. Indian fish-oil would answer, if more carefully extracted. [*Conf. with Dict. Econ. Prod. II., p. 675, Sier Fish Oil.—(Ed).*] Mutton or goat tallow is used either alone or mixed with cod-oil; in the latter state, it is called "dubbing," which is applied to all leather intended for harness or straps and like pliable purposes.

Cod-oil.

Tallow dubbing.

OPERATIONS OF THE TANNERY.

Native tanners and curriers are all of the *Chamar* caste; the former are *Runghias*, a trade class of that caste; such labour is very plentiful about Cawnpore. The wages vary from Rs. 5 to Rs. 9 per mensem according to skill.

Labour.

The hide when received green is only washed and put into a pit of milk of lime, but if it has been salted and dried out, it has to be soaked in soft water before it can go into lime. It is often so hard dried that it will not soak down, and heavy fulling stocks are required to break it down and soften it ready for the liming process.

Liming.

The hides are first put into weak lime and then into stronger, until the hair is loosened and the skin "plumped" up; they are then placed over tanner's beams made of cast iron, and convex, so that a two-handled blunt, concave knife can be worked over them to push off the hair. When this has been accomplished, the hide is turned over on the same beam, and the flesh and fat which was left on and has now become loosened by the action of the lime, is shaved off by means of a two-handled concave fleshing knife, which has a sharpened edge, and takes off a greater or less shaving as required. Some dexterity is needed in this work, as a slip of the knife may shave too deep and cut into the hide. The most skilled tanners are employed in this, and called beamsmen.

Unhairing and fleshing.

There is great diversity of opinion in the trade as to the use of lime. It is generally allowed that it is an evil but a necessary one; it is not good for leather, but the hair and flesh must be removed, and there is no safer way of doing so. In the French and in some of the American tanneries the hair is removed by sweating the hides, and producing partial decomposition, but this would be too dangerous in a climate like that of India.

Use of Lime.

* *Conf. with p. 90.* The various forms of **Sumach** are obtained from **Rhus**; some four or five are common bushes and trees on the Himálayas, particularly **R. Cotinus**—the **Venetian Sumach**. The true **Sumach** (**R. Coriaria**) is common in Afghanistan, and might easily be cultivated in India, but the properties of the wild Himálayan forms of **Sumach** have not been satisfactorily determined.—[*Ed.*]

Tanning as Practised in India—

TANNING.

Graining or Bating.

Lime being an evil, it becomes necessary, after it has done its work, to rapidly obliterate all traces of it in the texture of the hide, and this forms the second process of the tanning and is called "bating." Sole leather does not require this process, but for all harness and dress leather and for every soft purpose it is essential. The hides after being unhaired, fleshed, and washed,

Bran grainer.

are thrown into a pit called a "grainer," in which bran and water have been allowed to ferment; the acid thus produced removes the lime from the texture of the skin and loosens and distends the pores, so that they are cleaned of every foreign substance and brought into a state highly sensitive to the action of tannic acid.

Much caution is needed in India in the management of grainers, for if the hides are left a few minutes too long, the acid dissolves the gelatinous materials, the action being quicker than in England owing to the higher temperature.

Pigeon or hen dung grainer.

Bran being sometimes expensive, the ammonia from pigeon or hen dung has been tried with some success; this is a usual grainer in England, but there has been difficulties in collecting sufficient quantities of it at Cawnpore, and even when procured, it is often so full of extraneous substances that bran is preferable.

Stale liquor grainer.

The native tanners of Cawnpore use a grainer of stale fermenting tan liquor, and this is so inexpensive that it is used for all heavy leather in the Government tannery. It is notable that the French use stale rotten liquors to bring down or soften their skins, and they are most successful in their soft pliable leathers.

Sulphuric acid grainers.

Weak solutions of sulphuric acid have been tried, to plump up the skins; but the acid is expensive, and all the above mentioned grainers give more or less the same result. An experienced tanner can tell by feeling the hides whether they have been brought down enough, and are fit for the next process, which is the tanning proper.

After the process of bating has been gone through and before being taken to the tan pits the hides are once more put on the beam, and all dirt, short hairs, &c., removed. A new and recently patented process of bating is being tried in the Harness and Saddlery Factory at Cawnpore. The process consists simply of using carbonic acid gas to swell the hides and get rid of lime and greases by chemical action. The gas is generated in the usual way from whiting and sulphuric acid; and is introduced into a pit where the hides and skins are in water. After an hour or an hour and a half, the chemical action separates and deposits the lime, and the greases come out in the form of soap; and by scudding the hide over a beam, all the impurities are dissipated, and the hide is far better prepared for the tan-yard than by any of the old processes.

Bark grinding.

Babul bark is broken and ground in a bark mill with breakers. The latter breaks the fibres of the bark, and the mill crushes and grinds it, thus rendering it easy of infusion in cold water and facilitating the extraction of tannin. Three mills with breakers are used at Cawnpore for this purpose which are driven by a powerful steam engine.

Myrobalans are ground and crushed in a disintegrator which is specially made for the purpose.

Tanning proper.

First infusions are made in the bark-taps above described, with fresh cold water. Soft water is of course the best both for this and for soaking hides in during the first stages in the beam house, but water should be free of lime even for the tanning process.

Infusing bark.

English tanners who produce cheap articles infuse with hot water; but this is not considered good as it extracts too much of the colouring and other earthy

A Note prepared by the Officer in charge of the Cawnpore Tannery.

matters, and hastens the development of gallic acid which is injurious to the liquors. TANNING.

After a pit of bark has given off a liquor, the half spent material is cast over into one of the spenders, where afterward another half spent liquor is put on it, the mixture being freshened up and so on till the bark is quite spent, when it is thrown out. The liquors are continually worked over and over again to spend the bark. Spending bark.

The hides are first put into the oldest or weakest liquor. In the state in which they come from the grainer they should not be subjected to the too sudden action of tannin; they are therefore continually handled or taken in and out of the pits. The pits are called "handlers." For the first month the hides are handled daily, then gradually allowed to remain longer and longer till they are fit for the next stage, which is called dusting. The pits are called "dusters." The hides are put into a stronger liquor with some finely ground bark thrown in between each layer of four or five hides, to keep the strength of the liquor up as the hides suck in the tannin. Handling. Dusting.

In the dusters, the hides are taken up weekly, and then fortnightly, when new liquors are supplied and fresh bark added.

The dusting goes on for three or four months, and then the hides are ready for laying away. The pits are now called "layers," and the hides are put into a new strong liquor, with quantities of fine bark between each. In these pits they lie for a month or two at a time absorbing the tannin. The half spent liquor from layers, dusters, and handlers are always drained off on to the top of the spenders, and these after being freshened up are brought up again by means of the pump; thus they are kept moving, which is very important as it retards the formation of gallic acid which is injurious to the tannin, and which is but too apt to form in hot weather. Laying away.

Babul bark and myrobalans are infused together, and the addition of the latter adds great strength, and takes away from the deep colour of the liquors.

The hides are kept three or four months in layers, and by that time in general the tannin has penetrated right through them, and they are tanned. Buffalo hides take from nine months to a year from first to last according to weight and substance; cow hides are tanned in from four to six months; sheep and goat skins are done in tubs, and take from a month to two months. Time taken in tanning.

The climate of India is favourable to the penetration and combination of tannin with the gelatine of hides. The chief danger to be guarded against is the fretting of liquor, and production of gallic acid, a compound more readily produced in Indian Tanning owing to the atmospheric heat.

After the hides are tanned, they can be dried and stored, but in this country they are apt to dry so hard, and to darken so much by the action of light and air that it is thought best to curry them at once, especially for harness work or dress leather. For sole leather or crop hides no currying is required, but they are struck, that is, pressed down and rolled, and then stored.

NATIVE PROCESS OF TANNING.

Native tanners carry out the liming process very much like that described; they, however, rather overlime the hides according to English ideas. Their grainer is very effectual as far as softening the skins; they then rinse out all moisture, and, while the pores are yet opened, they work the hides in liquor, and afterward they sew the hide up into a bag having one end open. This bag is filled with finely pounded bark and hung up over a pit from which liquor is ladled into the bag, and there a very strong infusion is formed which percolates through the pores of the hide. This tannin therefore goes right through the hide, but it has not time to make the chemical combination, which is considered so essential for the leather. Native tanning does not occupy more than a week. Native tanning.

TANNING.
Currying.

CURRYING.

For harness and all dressing purposes, the currying is a most necessary and important process. By tanning, the hide has become leather, but it is not fit for use without currying. This consists of a number of manipulations, *e.g.*, stoning, shaving, scouring, oiling, reshaving or flattening, setting, resetting, dubbing and finishing.

Stoning.

For ordinary harness leather a buffalo hide, as it comes from the tan pits, is hung up till it is half dry, when it is stoned out with a rough stone on a flat table, to straighten it as much as possible.

Shaving.

It is then thrown over a currier's beam, an upright thick plank faced with Lignum vitæ. This is the beam board for shaving on. The hide is smoothed down the board, and the currier, with a two-handled shaving knife, having a turned edge, takes off the outer flesh and inequalities from the flesh side, in fact, levels the hide as nearly as he can do so, having regard to economy in not wasting leather. The object of this shaving is to get the hide to lie flat on a table, so that the scouring stones and sleekers may touch each part of the surface with equal pressure, and thus thoroughly clean it, as well as press out all dirt and bloom, or earthy deposit from the bark that remains in the tissue.

Preparing the shaving knife.

The preparation and use of the currier's shaving knife requires skilled men, each man sharpens and turns the edge of his own knife. He first rubs it and clears a perfect straight edge, then places his knife edge upwards, before him on the floor, holding it between his knees, and resting it against the wall; in this position he takes in both hands a heavy steel and presses it along the straight edge, with more or less pressure as required to turn the edge. This edge catches the lumps and inequalities of the flesh side and shaves them off. When shaved the hide is laid flat on a stone table, and undergoes a series of scourings and pressings out on both sides, to remove bloom and dirt and take out crease. After this it is steeped for two days in Sumach or Myrobalans to give it a finishing colour. These infusions are made with boiling water.

Scouring.

Steeping in Sumach water.

Oiling.

The hide is then taken to another table, and sleeked out on both sides with a steel sleeker; then, while still wet, cod-oil is rubbed on lightly on the flesh, and more heavily on the grain. It is then hung up to allow the oil to be drawn into the pores of the skin as the water evaporates.

Flattening.

When about three parts dry it is passed through a stoning machine and pendulum roller; this is done to make the leather firm and to get out the stretch, and, then, for a second time, it is placed on a currier's beam to be lightly reshaved on the flesh side, that is, the roughness is taken off without sacrificing much of the leather. This process is called flattening.

Setting on dub.

After this it is hung up again to dry a little more. It is afterwards stoned out on a table. Then the table or sufficient portion of a table for the hide to lie on is rubbed over with dubbing (a mixture of oil and tallow). The hide is laid on the dubbed table grain upwards, so that the flesh adheres to the table; in this state it is well set out, that is, the hide is stretched out as much as it will go by pressure with a hard setting stone with a smooth edge. To do this the hide is damped down in any place that it may have dried too much.

Resetting.

When fairly set, it is allowed to dry a little, then stoned out on the flesh side, and afterwards reset on the grain side, to prepare for the dubbing, which is now laid on with a brush, rubbed in and smoothed down with the palm of the hand.

Dubbing or stuffing.

Care must be taken that the hide is equally damped all over before it is 'dubbed,' otherwise the dry parts will remain dark in colour. In this dry climate it is very necessary to watch that hides do not get too dry in the processes of 'currying.' When dubbed, the hides are hung up to dry, and when the

TANNING. Finishing.

grease has gone well in, leaving a white coating of refuse-tallow on the outside, they can be taken down and finished off, which is done on a table. First the flesh side is smoothed with a pebble or glass, then the grain is 'sleeked' with a fine 'sleeke' to remove the coating of tallow, then sleeked with the pebble and glass to make smooth and bring up a gloss; the hide is then dried out. After all this the hide is ready for the saddler and harness maker. It is prepared for various other purposes with more or less dubbing, as the leather may be required for soft or for hard purposes.

Currying Cow Hides.

Cow hides do not require so much setting as buffaloe, but they have oiling and dubbing in proportion to their thickness. For very soft uses the cow hides are softened by hand labour with a crippling board which loosens the grain.

Sheep and Goat skins.

Sheep and goat skins are oiled and then set, and dubbed hung up and dried out, after which they are softened.

Tools for Tanning

The following tools are used in tanning:

Tongs for lifting hides out of lime-pits.
Unhairing, fleshing and rounding knives.
Tanner's hooks for lifting hides out of tan pits.
Scudding knives.
Striking pens.

and for Currying.

The following tools are used in currying:

Currier's shaving knives.
Sharpening and turning steels.
Scouring, pumice and setting stones
,, finishing and glass sleekers.
Pebble.
Stuffing brush.
Crippling board.
Rub-stone and clearing-stones for sharpening knives.

NATIVE CURRYING.

Native curry-ing

The natives neglect the currying process of their leather. There is no trade corresponding to the curriers in this country. The best harness-makers curry their leather before cutting it up into straps, in fact they curry it in strips of a foot wide, and apply tallow only; very often they apply nothing but butter-milk, which gives the leather a very bright appearance, but the moisture very soon evaporates, and the leather becomes hard and brittle.

CAWNPORE,
July 1888.

JOHN STEWART, R.A., *Captain.*

VOL. I.; PART I. (No. 10) 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

Correspondence regarding Coix Grain or Job's Tears and incidentally information regarding the Millets and Wheat of Burma.

From VISCOUNT CROSS, Secretary of State for India, to the Government of India,—No. 35 (Revenue), dated 5th May 1887.

I forward herewith a copy of a letter* which has been received from the Director of the Royal Gardens at Kew, respecting some remarkable seeds of Coix, known as Job's Tears, shown in the Indian Section of the late Colonial and Indian Exhibition, at present unrepresented in the collections at Kew.

* Dated 24th March 1887.

2. I shall be glad if you will give instructions for a small quantity of these seeds being sent to this Office for transmission to Kew.

From D. MORRIS, Esq., Royal Gardens, Kew, to the Under-Secretary of State for India,—dated 24th March 1887.

I am directed by Mr. Thiselton Dyer to mention that at the late Colonial and Indian Exhibition there were shewn some very remarkable seeds of Coix—known commonly as Job's Tears—used, on account of their size and beauty, by the Karens for ornamenting their clothes.

2. No seeds of this particular sort are represented in the Museums of Economic Botany at Kew; and it was found impossible to obtain those at the Exhibition, as they were worked as ornaments attached to Karen clothing.

3. Mr. Thiselton Dyer would esteem it a favour if you will be good enough to bring the subject under the notice of Lord Cross and ask his good offices in obtaining a small quantity of these seeds from India for this establishment.

OFFICE NOTE ON SEEDS OF THE COIX PLANT.

The particular form of Coix seed referred to is a narrow grain about ½ to 1 inch long used by the Karens to ornament their dresses and by the Angami Nagas of Assam to make earrings. I drew Mr. Dyer's

attention to these, and said I believed they were not the grains from the edible **Coix lachryma** but from a little known species which I think has been described as **Coix Kœnigii.** I should very much like that botanical specimens of the plant, as well as the grain, were procured and shown to me before being sent to Kew. While in the Naga hills, I made an effort to see the plant but failed. I have a suspicion that the Angami Nagas obtain their supply from Burma. In writing on this subject it should be clearly pointed out that the ovate or globular seed, cultivated and eaten throughout Assam and some parts of Burma, and known as Job's Tears, which is also sometimes used for necklaces and to ornament basket-work, is not the seed now called for. I would suggest that the Director of Land Records and Agriculture, Burma, be invited to put himself into communication with **Dr. Vinton** of the Karen Mission, as it was through that gentleman's kind assistance that the clothes in question were obtained. In writing to Assam it would be probably useless to call for Job's Tears; no other tribe in Assam, to my knowledge, employ the peculiar bead-like and cylindrical seed except the Angami Nagas. It would be desirable, however, to ask Assam Government that the Deputy Commissioner, Kohima, be invited to take one of the red-hair and boar-tusk earrings out of an Angami's ear and ask where he obtains the rosette of white seeds which surround the bluish-green beetle's wings which forms the central feature of that ornament.

(Sd.) GEORGE WATT,

Dated 3rd June 1887. *Reporter on Economic Products.*

From G. C. KYNOCH, Esq., Assistant Secretary to the Chief Commissioner, Burma, to the Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—No. 483—38A., dated 22nd November 1887.

With reference to your letter No. 468—85-2A., dated the 11th June 1887, I am directed to submit that a parcel containing three specimens of the seed of the Coix plant has this day been forwarded by post to the Under-Secretary of State for India, India Office, London, for transmission to Kew Gardens. A box containing three pressed specimens of the Coix plant, as well as some seed, has to-day been despatched to your address in accordance with the instructions contained in the last paragraph of your letter under reply.

Office Memo. from the Reporter on Economic Products, to the Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—No. 50—118-2 S., dated 22nd December 1887.

The parcel of Coix seed from Burma contains samples of the chief millets grown in that province, together with a small packet of the Coix seeds called for, and two badly-dried samples of the leaves of the plant. Of the bundles of leaves, one fortunately contained some 10 or 12 specimens with the seeds attached. The writer has damped and carefully opened out these fruiting specimens in such a manner that they may now be transmitted to Kew. He would remark that while he fully believes these represent a plant once shown him by the late **Mr. S. Kurz** as **C. Kœnigii,** and referred to in his preliminary Report on Pegu, p. xxiii—as the *Kyaip* of the Burmese, there would now appear to be little ground for viewing the plant as anything more than a peculiar form of the common **Coix lachryma. Kurz,** however, mentions **Polytoca heteroclita** (the *Myet yá*) as met with in Pegu. This point can be more accurately solved at Kew than in India. But the writer would suggest that of the specimens which he has mounted set (1) should be deposited in the Calcutta Botanic

Garden's Herbarium; (2) in the Saharanpur Herbarium; (3) should be returned to the Director of the Department of Land Records and Agriculture, Burma; (4) sent to the Director of the Department of Land Records and Agriculture, Central Provinces; (5) to the Director of the Department of Land Records and Agriculture, Bombay; (6) to the Director of the Department of Land Records and Agriculture, Madras; (7) to the Director of the Department of Land Records and Agriculture, Assam. The remainder might then be transmitted to Kew with a letter advising of the above action, and promising that should the specimens thus distributed bring further information to light regarding the plant, the Director of the Royal Botanic Gardens, Kew, will be placed in possession of the same.

2. The undersigned thinks that this subject might be once and for all disposed of. The grain is not likely to prove of any great economic value as a source of food, but it stands an admirable chance of being largely used in Europe in the construction of artificial flowers, laces, bugle-trimmings, and other purposes for which glass beads are being used. If capable of being dyed a deep black colour, there might be a very extensive demand, since such beads would be infinitely more durable than glass. During the Exhibition, several gentlemen, especially from France, enquired after seeds suitable for the above purposes. The writer was not able at the time to furnish them with samples of the cylindrical form of Coix now under consideration, but showed them the ordinary spherical form. They seemed to think there was some prospect even of the common spherical form coming into use, but objected to its large size. This led the writer to show them the Karen garments with the cylindrical form of seeds used for decorations. This they were highly pleased with. In hopes of still further developing the matter, the writer drew Mr. Dyer's attention to them with the result, he believes, that the present enquiry has been instituted.

3. There are certain points which it would be desirable to ascertain, and the issuing of the specimens suggested above would greatly facilitate their solution. These are:—

(*a*) Is the plant cultivated or wild?
(*b*) If the former, is the globular form grown as an article of food or only for ornamental purposes?
(*c*) Are the two forms—globular and cylindrical—known by separate vernacular names? What are these names?
(*d*) Is the cylindrical form ever found of a grey or black colour as is the case with the globular?
(*e*) Are there any sayings or proverbs about the plant; in other words, do the people hold any peculiar ideas regarding one or other form which might help to throw some light on its cultivation?
(*f*) How much might be annually furnished of the cylindrical seed, and at what price?

4. The writer has not thought it desirable to return the samples of millets found in the parcel obtained from Burma, as these are some of the ordinary species found in India; but he has noted the information furnished regarding them for future use. It may be added, however, that in the bottom of the box there was found a packet of the globular form of **Coix lachryma** with the following note regarding it:—"This may be Coix, but I think it is Sorghum. It is the kind which **Mr. Theobald** thinks comes from Coix by cultivation." It is certainly Coix and not Sorghum; but the idea is suggested by the above remark, that in Burma the cylindrical form is the wild plant, and the globular the result of cultivation from that form. It would be highly desirable, therefore, to ascertain definitely from Burma whether the globular is cultivated, and the cylindrical wild. This has never been the experience of the writer.

Throughout the greater part of India he has collected the globular form as a wild plant, but has never seen the cylindrical form either wild or cultivated. In Manipur and the Naga hills, the globular form is grown as a regular agricultural crop, and with the Tankhul Nagas forms perhaps their chief food. In Chutia Nagpur, on the other hand, Coix is regarded as a great source of annoyance in the rice fields, and is neither cultivated nor eaten. The writer's experiences of Burma are not very extensive, but he cannot recall having ever seen either the wild or cultivated form on the Burmese frontier of Manipur, or in Lower Burma in the neighbourhood of Rangoon or Moulmein.

5. Might the writer be permitted to say that in forwarding the specimen suggested above to the Director of the Department of Land Records and Agriculture, Burma, that officer be desired to furnish this office with any available information regarding the millets grown in Burma, as also the vernacular names for the same, in Roman type—those given in *Mason's Burma* being in Burmese character are not understood. The writer, for example, was not aware that Sorghum vulgare—*jowar*, the greater millet—of which a sample has been now furnished, was grown to any great extent in Burma; still less that it was used by the Karens in the "distillation of whiskey." It would be most desirable to have the vernacular names given for that millet in the various languages of Burma, and also any available information as to the extent of its cultivation; and, if possible, any local information that might throw some light on the subject of the date of its introduction into Burma. In like manner the writer cannot discover any information as to the cultivation of Setaria italica—*Kangni*—in Burma, although he has now had the pleasure to receive an excellent sample with the remark: "A specimen of the millet which has longer heads than the common." The same information as desired above might be furnished regarding this plant, together with samples and information about all the other millets, including the "common" species referred to in the above remark found attached to Setaria italica. Mason does not apparently allude to Setaria italica. Now that such an enquiry might be possible, it would be most instructive to have Mason's remark confirmed regarding an extensive cultivation of wheat in Upper Burma. To facilitate the enquiry, the writer would like to see a few samples of the characteristic wheats of Upper Burma, and to be furnished with their vernacular names, and other information available, since interest seems likely to be soon taken in the subject of these wheats, and in the vast plains and undulations of rich wheat soil that have so recently fallen under British rule.

NOTE BY THE EDITOR.—As the outcome of the above circular note, a very extensive correspondence has ensued both on the subject of Coix and the Millets and Wheats of Burma. About the same time the writer had to send to the Press the article on Coix for the *Dictionary of the Economic Products of India*. This incorporated the facts received by the above mentioned correspondence up to date of publication of the pages in question, but, subsequently, much further and useful information has been received. The present number of the Selections is intended to place in the hands of the public an abstract of all that has been learned.

From the Director, Botanical Department, Northern India, Saharanpur, to the Officiating Under-Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—No. 206, dated 4th February 1888.

I have the honour to acknowledge the receipt of the specimens of Coix as advised in your letter No. 55—20-3 A., dated 28th January 1888, and of a copy of a letter from the Reporter on Economic Products relating to the same.

Never having previously had an opportunity of seeing specimens of this very interesting grass, I am unable to give answers to any of the

questions contained in paragraph 3 of Dr. Watt's letter. The ordinary form of **Coix lachryma** with ovate or pear-shaped seed-cases is abundant in Northern India in wet ground, and I have never observed it except as a wild plant. The shape of the seed-case varies from nearly globular to that of an oblongated pear, but never approaching to the narrow cylindrical shape assumed by the Burmese example, which, judging from the specimen alone, I should have been inclined to consider a distinct species.

From GEORGE KING, Esq., M.B., LL.D., &c., Superintendent, Royal Botanic Gardens, Calcutta, to the Officiating Under-Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—No. 11 G., dated 28th February 1888.

I have the honour to acknowledge receipt of your letter No. 56—20-3 A., dated 28th ultimo, its enclosure, and the specimens which accompanied it. The latter have been deposited in the Herbarium.

2. With regard to the points mentioned in paragraphs 3 and 4 of the enclosure, I have the honour herewith to submit some remarks by Dr. D. Prain, Curator of the Herbarium.

The following is the information yielded by the specimens of **Coix lachryma**, *L.*, gathered in Burma and preserved in this Herbarium.

(*a*) Specimen collected at Hotha during the Yunnan expedition by Dr. J. Anderson (1868); not noted whether wild or cultivated.

Fruits irregularly globular, colour grey, skin wrinkled, length 9 mm., breadth 11 mm.

(*b*) Do. do. in Pegu by Mr. Sulpiz Kurz.

Noted "along margins of mixed forest, Yomah." This might be wild or might be an escape from cultivation.

Fruits distinctly ovoid, colour grey, skin wrinkled, length 12 mm., breadth 8-9 mm.

(*c*) Do. from Burma dated 1875 without note as to being wild or cultivated.

Fruits smaller, sub-spherical, colour milky white, surface smooth, glistening, length 6 mm., breadth 5 mm.

(*d*) Do. by General Collet, C.B., marked "grass so common in the lake, Fort Stedman."

Noted—"the Shans use the seeds of this grass to ornament their bags and women's dresses, &c."

Fruits ovoid, colour brown, surface smooth, glistening, length 11-12 mm., breadth 7 mm.

Coix with cylindrical fruits has not hitherto been reported from Burma to this Herbarium.

Sorghum vulgare has been known to be a Burmese grain, at least since 1849; is reported from Moulmein in that year by Dr. Falconer; and later by Dr. J. Anderson and Mr. Kurz.

Setaria italica has similarly been known to be a Burmese grain, at least since 1855; being reported in that year from the banks of the Sittang by Mr. Robert Scott from Pegu, native name *Zamee* by Mr. Kurz, and from Karen *Toungyas*, *Pookee* by the same botanist.

D. PRAIN,

Curator, Herbarium, Royal Botanic Garden.

From the Director, Botanical Department, Northern India, to the Offg. Under-Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—dated 12th March 1888.

With reference to Dr. Watt's letter No. 99—118-7 S., dated 18th February, a copy of which I have received with your No. 229—20-9 A., dated 3rd March, I have the honour to submit the following remarks regarding the specimens referred to.

Since the date of my former letter, No. 206 of 4th February, I have had an opportunity of consulting the Herbarium in the Royal Botanical Gardens at Calcutta and have ascertained that the specimens in question are not those of any species of Coix, but belong rather to **Polytoca**, a genus differing from Coix in having the shell-like seed-case formed by the hardening of the outer glume and not by the bract, as in Coix. **Dr. Watt's** specimens agree exactly with specimens in the Calcutta Herbarium, named **Polytoca Wallichiana**, *Benth.* (*syn.* **Cyathorhachis Wallichiana**, *Nees*). Some of the Calcutta specimens were collected in Lower Burma by the late **Mr. S. Kurz**, and others are from Singapore—contributed by **Dr. J. Anderson.**

From W. T. HALL, Esq., C. S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products to the Government of India,—No. 580—17 A., dated 25th April 1888.

With reference to letter No. 57—20-4 A., from the Under-Secretary to the Government of India, Revenue and Agricultural Department, dated the 28th January 1888, with which there was forwarded a copy of your note No. 50—118-2S., dated the 22nd December 1887, regarding Coix seed from Burma, and asking for further information about millets and wheat, I have the honour to forward herewith eleven specimens of Coix, millet, and wheat with the information at present available regarding each. I expect to receive more samples and to get fresh information, when I will communicate with you again, but, meantime, I am sending these specimens that they may reach you in good order. A note is attached in which is given the names of the different specimens in Burmese and the districts in which they are grown.

NOTE.—The scientific names of the grains forwarded by this letter have been given within [ ] and were added to the original M.S. while the Dictionary article was being prepared. The numbers assigned to them on the margin of the present note have also been recorded on the samples.

MILLETS.

[1] [**Sorghum vulgare**] *Hnan-pyaung.*—Grown in Pyinmana District; sown with maize in May, June; ripens in July, August; crop is sown on high land. Plant resembles Indian maize, but the leaf is smaller and the plant taller. The seed is as large as No. 4 shot (See sample).

[2] [**Panicum miliare**] *Sat.*—Same district, similarly cultivated; looks like *Kaing* grass (elephant grass), but is not so high as the maize plant, and has a smaller leaf than *Hnan-pyaung*; seed is globular and looks like snipe shot. These millets are grown for home consumption only.

[Is the name *Kaing* an Indian or Burmese word? **Brandis** gives 3 grasses (forms of **Saccharum**) as the *Kaing* of Burmese forests. (Conf. with page 132.—*Ed.*).]

[3] *Pyaung legauk* (red)—Kyauksè District.

[4] *San-byaung* (white) Do. do.

These are sold at from 8 to 12 annas the bushel, and are largely grown and used as food by the poorer people who cannot afford rice and also as fodder for cattle.

[Sorghum vulgare white and red grains, of which No. 1 is a twig.]

Gyón wa—Yellow wheat, Kyauksè District. [5]

Gyón ni—Red wheat do. do. [6]

They are much the same in quality and value, but the latter is more durable, withstanding the attacks of insects better than the former. Both kinds are grown to some extent, the crops coming on in October and November. [Triticum sativum, two forms of hard wheat below.]

Coix.

(In Burmese *Kyeit* and sometimes *Kalithi*.)

[Coix lachryma] *Coix—Kyeit*—From Kyauksè District; not cultivated but found growing wild in small quantities in the globular form (sample sent). The seeds are not used. [This is a steel-grey form, hard, shining, and not furrowed.] [7]

Coix—Kyeit—From Jaye in Bassein District; planted in plantain gardens; ripens in November; used for food but not as ornaments; only globular specimens found. [Is a brown soft-shelled form with distinct furrows.] [8]

Coix—Cultivated, globular *Kyeit*, grown in Thabaung, Bassein District. Price is ₹2 to ₹3 a bushel. Cultivated like No. 8. [9]

[Brown, shining grain, hard and not furrowed, nor possessed of the disk-like swelling at the base. This has all the characters of being a wild grain, and I suspect a mistake having been made in the above note regarding it.]

Coix—Kyeit—Globular, found growing wild near Ngaputaw, Bassein District. [This is a mixture of two or three forms.] [10]

Coix—Cylindrical, called *Kyeit*. It is cultivated by Karens on high land. I did not meet the persons who planted this *Kyeit*. It is used for ornamental purposes and not for food. [This is the *var.* stenocarpa, and one of the best examples as yet seen, as it is very narrow and long.] [11]

Office Note by the Reporter on Economic Products, on No. 580—17A., received from Burma, arriving 4th May 1888.

Forwards for information and orders of Secretary the copy of a letter (above) which he has received from Burma, apparently in continuation of the circular letter issued by Revenue and Agricultural Department regarding Coix and other millets in Burma.

2. The notes within brackets are by the writer, and will be found to give the scientific names which he has arrived at from the inspection of the samples.

3. There is very little of a special interest to comment on regarding the two millets furnished, except that the vernacular names are most useful, and the brief notes regarding their modes of sowing will come in useful in connection with the *Dictionary*.

4. The samples of wheat, Nos. 5 and 6, appear to be good qualities of hard wheats similar to some of the Bombay forms. The concluding words of the writer regarding these are very remarkable, *viz.*, "the crops coming on in October and November." This would almost convey the idea that the Burmese wheat was a *kharif*, not a *rabi* crop. The idea, however, which was probably meant to be conveyed was that they were sown in the months named, and, indeed, this view might be accepted, but for the fact that the writer's attention has been arrested recently by similar statements which would seem to suggest that in some parts of India there is

actually a *kharif* crop of wheat. For example, in the *Poona Gazette*, Part II., p. 38, the following remark occurs regarding a form of wheat known there as *khaple*. "It is sown as a second or *dusota* crop in January and February on irrigated lands, after *bajri*, maize, tobacco, chillies or wheat, with good results." Such a crop would most probably ripen in October and be thus a *kharif* crop.

5. If the Secretary sees no objection the writer would like to ask Mr. W. T. Hall to kindly look into this matter again. The idea of *kharif* wheat in India appears to be a fact new to the literature of European as well as of Indian Agriculture—the fact, *viz.*, that as with rice so also with wheat, there would appear to be two crops.

6. The concluding notes in Mr. Hall's letter regarding Coix have come in very opportunely for the *Dictionary*, and will be reserved until replies are received from other provinces before being amalgamated in a general note for the Selections.

From W. T. HALL, Esq., C. S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products to the Government of India,—No. 383—17 A., dated 15th May 1888.

In continuation of my letter No. 580—17A., dated 25th April 1888, I have the honour to forward herewith specimens of Coix from the Akyab and Kyaukpyu Districts of the Arakan Division of Lower Burma. Extracts from the letters with which the specimens were sent are attached.

2. From Akyab District there are sent one packet of seeds collected in Myohaung (Old Arakan) and three small packets of seeds collected in Akyab.

3. The Deputy Commissioner of Kyaukpyu has apparently sent two specimens of plants and three of seeds. The specimens have not been clearly marked. However, another reference to that district would result in considerable delay, and as the specimens may be damaged if not forwarded to you, I am sending them on at once.

Extract from a letter No. 444—158, dated 27th April 1888, from the Deputy Commissioner, Akyab, to the Commissioner, Arakan Division.

* * * * * *

2. Coix seed of both the globular and cylindrical form is commonly known in the district, as well as in other parts of Burma as . . . . . The globular grows wild in low marshy land and is not edible. The cylindrical is sown by the wild tribes—the . . *Moos* and the . . *Kwe mees* in *kaing* land or on slopes of hills. They do not till the land for this purpose; the seeds are thrown broadcast, and no care is taken of them. In times of scarcity of food the cylindrical are eaten, but now they are only used as ornaments for their dress.

[12] [13] [14] [15] I send you samples in three packets of the globular seeds collected in the town of Akyab; they are of three colours—white, grey, and dark grey. I also send in a separate packet samples of the cylindrical seeds of a grey colour collected in Myohaung, and these are edible. [The so-called cylindrical sample of this collection is not *var.* **stenocarpa**, but is one of the most remarkable of all the Coix grains as yet received. It is very large, is pronouncedly furrowed and has a well-marked basal disk.]

Extract from a letter No. 36—8-2, dated 29th March 1888, from the Deputy Commissioner, Kyoukpyu, to the Commissioner of Arakan.

* * * * * *

2. I forward herewith a bunch of the plant (dry), with roots and earth adhering, to which the whitish-blue pear-shaped seeds belong. This plant grows wild and plentifully, and came, I understand, from the Old Kyaukpyu Circle. The seeds, which are of a convenient shape and pleasant colour, are used for purposes of ornament, but no attempt seems made to cultivate or improve the quality. [16]

The second variety is a commoner one, with large round seeds, used by children for necklaces (and it is believed by Chins), but devoid of beauty of form or colour. It is now marked B. Being of little value no sales of the seed are known to occur. [17]

The former (A) is called *Jaisee* or *Kalinsee* (big variety). The kind (B) is called *Chitsee*. It grows in June and July, and dies in November and December. The plant is 4 or 5 feet high, and like a reed. [18]

The third variety (C) goes by the name of *Chitsee* and is a more delicate plant, cultivated by Khynis on their *toungya* for (1) food and (2) for *Khaung* or *Omall* beer used by hill-men. The seed has to be cleaned and has the taste of maize. Some of this kind is grown in the Au Township. [19]

4. I also enclose a bundle with seeds similar to that marked (A). The seeds closely resemble those in A, but are not quite so bluish in colour. The plants, however, seem to differ widely in other respects. I am unable to say if they both belong to the same variety or not. I have marked this (D). [20]

NOTE BY THE EDITOR.—The specimens A, B, and C. are **Coix lachryma**, but D is the seeds of the spiny bush **Cæsalpinia Bonducella**, and must have got by mistake among the samples of Job's Tears. A necklace of the Coix marked A is also furnished.

A communication received from the Assam Government regarding the Coix grain in the Nága Hills and also in the Khásiá and Jaintia Hills will be found at page 142.

From W. T. HALL, Esq., C.S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products with the Government of India,—No. 715—17A., dated 28th May 1888.

In continuation of my letter No. 383—17A., dated 15th May 1888, I have the honour to forward herewith specimens of Coix from the different Districts of the Pegu Division of Lower Burma. A statement is attached giving the information required regarding the production of Coix.

[NOTE.—The samples of Coix forwarded by this letter are, from a commercial point of view, the most interesting of all those the writer has seen. This will be found dealt with fully in the reprint from the *Dictionary of the Economic Products of India*. The hard globularly flattened forms seem highly suited for ornamental purposes.]

For the tabular statement see next page.

Information regarding Coix Seed. (*The columns answer the questions asked at page 115.*)

	District.	(*a*) Is the plant cultivated or wild?	(*b*) If cultivated, is the globular form grown as an article of food or only for ornamental purposes?	(*c*) Are the two forms, globular and cylindrical, known by separate vernacular names; what are these names?	(*d*) Is the cylindrical form ever found of a grey or black colour as with the globular?	(*e*) Are there any sayings or proverbs about the plant?	(*f*) How much might be furnished annually of the cylindrical seed, and at what price?	Remarks.
[21] [22] [23] [24] [25]	Pegu . .	The globular form grows wild plentifully, but is not used. One variety is cultivated. The cylindrical form never grows wild; it is always cultivated.	Grown for food.	The plant is known by the name of *Kyeikthi*. No trace of separate names.	The cylindrical form seems to be always white.	*Nil.*	A little is grown near Pegu, but it is of very bad quality. A better quality is grown in the upper valley of the Pegu river, but the supply is insignificant.	Samples of five varieties put up in boxes marked "Pegu."
[26] [27] [28] [29] [30] [31] [32] [33] [34]	Hanthawaddy. } Large samples.	Both kinds are grown by the Hill Karens.	One kind (sample A) found only in the plains is raised to a very small extent as an article of food and sold at 8 annas per basket. The remaining kinds are used as ornaments. A=26.	Commonly called *Kyeik thi*. [Note.—For a fuller reference to this page	...	*Nil* ese forms see 140.]	... the remarks at	Seven packets in wax cloth marked A to G, and also two other bags of seed marked "Hanthawaddy."

[35] [36] [37]	Prome .	Both the globular and cylindrical kinds are said to grow wild. They are also cultivated to some extent by Hill Karens.	The *Sakyeik* (edible-*Kyeik*) is grown for food.	Known generally as *Kyeikthi*. The cylindrical variety is called *Kyeikshe* (literally long *Kyeik*). Some of the varieties of the globular form are thus designated :— *Kyeikphyu* or White-*Kyeik*. *Sakyeik* or Edible-*Kyeik*. *Pyaung Kyeik* or Maize-like *Kyeik*. *Kyeikni* or Red-*Kyeik*.	Always white, never known to be grey.	*Nil.*	Not sold, cultivated to a very small extent.	Three bags of specimens marked "Prome."
[38]	Tharrawaddy.	Grows wild. In Gyobingauka little is cultivated, and sold at ₹4 a basket among the Karens.	One large round edible kind called *Bè* cultivated for food; another small round Coix called *Bè-ma* (female *Bè*) for ornamental purposes. :	Common Burmese name *Kyeikthi*. In addition to the two kinds of which the Karen names are given in the preceding column, there is a long kind called by the Karens *Be-Kwa*.	The only colours are white and red. It is generally found white.	*Nil.*	Impossible to say how much could be furnished. Supply would equal the demand. Price would probably be ₹3 to ₹4 a basket if grown extensively.	One packet of samples of Coix seed marked "Tharrawaddy."

Coix Seed.

The mode of cultivation is as follows :—

1st—Before the seeds are put in the ground, they are tied in a piece of white cloth and watered every day for about seven or eight days, when whitish roots appear. They are then placed on the ground. In some cases the roots did not appear till ten or fifteen days after.

2nd—At the place where the plants are to be grown furrows are formed and the seeds are laid on the earth which is first mixed with cow's dung, afterwards they are covered up with a little earth.

Another method is to dig a hole where dung and decayed leaves are burnt and plant the seeds in such places. This method is considered to be more successful.

When the plants bear fruit, and the latter becomes mature and grows white, the branch should be broken off. This will yield more fruit and cause the plant to last longer.

The people are not in the habit of buying and selling these seeds.

From W. T. Hall, Esq., C.S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products with the Government of India,—No. 287—17 A., dated 11th June 1888.

In continuation of my letter No. 715—17A., dated 28th May 1888, I have the honour to forward herewith specimens of wheat and millets which have been received from the Meiktila District in Upper Burma.

2. Wheat is not extensively grown in that district and but one sample is available.

3. There are five kinds of millets grown, *i.e.*:—

[39] (A) Pyaung shwe wa . . . . . Golden millet.
[40] (B) Pyaung ni . . . . . Red millet.
[41] (C) Pyaung mwai . . . . . Grey millet.
(No sample sent.)
[42] (D) Pyaung net . . . . . Black millet.
[43] (E) San Pyaung . . . . . Rice millet.

[Note.—The sample of wheat No. 39 is a shrivelled, poorly developed, hard red wheat. Nos. 40, 41, 42, and 43 are forms of **Sorghum vulgare.**]

From W. T. Hall, Esq., C.S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products with the Government of India,—No. 504—17A., dated 19th June 1888.

In continuation of my letter No. 287—17A., dated the 11th June 1888, I have the honour to forward a tabular statement showing, for the Tenasserim Division of Lower Burma, the information you require regarding Coix.

2. I am also forwarding seven specimens of Coix from the Mergui District of that Division.

[Note.—Of this collection of Coix Nos. 44, 45, and 47 are said to be cultivated, and the soft furrowed shell confirmatory of this is present in all; No. 44 is a small black shining grain; No. 45 a brown grain medium-sized; No. 47 a very small white grain. Nos. 48 and 50 are wild globular grains fully bearing out all the characters of the wild Coix, but No. 48 is a white flattened grain highly suited for ornamental purposes, smaller and more flattened than B, D, E (27, 29 and 30) of the Hanthawaddy collection. No. 50 is a large white useless form. Nos. 46 and 49 are forms of the *var.* **stenocarpa,** the latter being the short-bellied condition, like C (28) of the Hanthawaddy set.]

DISTRICT.	(*a*) Is the plant cultivated or wild?	(*b*) If cultivated, is the globular form grown as an article of food or only for ornamental purposes.?	(*c*) Are the two forms, globular and cylindrical, known by separate vernacular names; what are these names?	(*d*) Is the cylindrical form ever found of a grey or black colour as with the globular?	(*e*) Are there any sayings or proverbs about the plant?	(*f*) How much might be furnished annually of the cylindrical seed; and at what price?	REMARKS.
Amherst . .	Globular and cylindrical kinds are cultivated—former for food as a delicacy, latter for ornaments for womens' dresses. One globular variety grows wild and is useless.	Grown as an article of food.	Both known as *Kyeit.*	Cylindrical kind is almost invariably white.	None known.	Any quantity might be grown according to the demand.	
Shwegyin. .	...	...	...	...	...	...	Coix not known.
Toungoo . .	Cylindrical grows wild, globular kind is cultivated.	Globular form is grown as an article of food and for making beer. The cylindrical is used for ornaments only.	Both known as *Kyeit* .	Cylindrical kind is grey.	None known.		
Tavoy . .	Both kinds grow wild, but are also planted by Karens in hill clearings.	Globular form is chiefly used as an article of food when rice fails, but is also used to decorate dresses.	Both varieties known as *kyeit* and *kalithi.*	Cylindrical kind is not found grey or black.	None known.	Cannot be estimated.	

Information regarding Coix Seed.

	District.	(a) Is the plant cultivated or wild?	(b) If cultivated, is the globular form grown as an article of food, or only for ornamental purposes?	(c) Are the two forms, globular and cylindrical, known by separate vernacular names; what are these names?	(d) Is the cylindrical form ever found of a grey or black colour as with the globular?	(e) Are there any sayings or proverbs about the plant?	(f) How much might be furnished annually of the cylindrical seed, and at what price?
[44] 1 [45] 2 [46] 3 [47] 4 [48] 5 [49] 6 [50] 7	Mergui. Principally in the Palaw Township.	Nos. 1, 2, and 4 are cultivated, others grow wild.	Nos. 3, 5, and 6 are used by Karens as ornaments both as beads for necklaces and on their dresses. No. 4 is used extensively as a food grain.	1. *Kaleit* (globular) . . . 2. *Kaleit Kauk Huyin* (globular). 3. *Kaleit Sinswè* (cylindrical). 4. *Kaleit Paukpauk* (globular). 5. *Kaleit Yinkwè* (globular). 6. *Kaleit Yain* (cylindrical) 7. *Kaleit Kyauk* (globular).	Cylindrical form appears to be white.		
	Salween. Hill tracts.	Globular form grows wild; both forms are cultivated to a small extent only in this district.	Globular form is used as an article of food and also for ornamental purposes.	Both known in Burmese as *Kyeit*, also *Kyeithi she* (cylindrical), *Kyeit thi lon* (globular). In Shan as follows: *Malwe leit amun* (globular). *Malwe leit ayaung* (cylindrical). In Karen as follows: *Bawmu* (globular), *Bawkwa* (cylindrical). In Karenni as follows: *Tabusè* (globular), *Kulèsè* (cylindrical).	Always white.	...	The plant is extensively grown in the Shan States, where it is sold at Rı the bushel for the cylindrical seed and 4 to 6 annas for the globular.

From W. T. HALL, Esq., C.S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products with the Government of India,—No. 195—17A., dated 17th July 1888.

In continuation of my letter No. 504—17A., dated the 19th June 1888, I have the honour to forward herewith some specimens of millets and wheat from the Minbu District in Upper Burma. Coix apparently is not known in that district. The Deputy Commissioner states that the millets called *Lu* and *Sat* are early crops. The *Lu* and *Sat* are about two feet high and the *Pyaung* about eight feet, more or less. It is a later crop than the other two. All these millets are extensively grown in Minbu. *Lu* and *Sat* ripen in three to four months after sowing, and then sometimes a crop of *Pyaung* is taken off the same land. **Millets.**

Wheat is not much grown in Minbu. It is cultivated in the low banks of the river as the flood subsides. The *Taminchauk* is said to be the best variety. **Wheat.**

2. There is attached a statement giving the Burmese names of the specimens forwarded from the Minbu District with their English equivalents. The names of the grains are also marked on the packets. I found a weevil in one packet I examined, so it will be advisable to open out the specimens as early as possible. [They have all been poisoned with corrosive sublimate.—*Ed.*]

3. I, at the same time, beg to forward a packet of Coix procured from the Kachin Hills adjoining Myadaung. A copy of the Deputy Commissioner's letter is attached (No. 929—58R., dated 13th June 1888) in which is given such information as is available regarding the Coix of which specimens are forwarded.

Specimens from Minbu District.

Burmese name.	English equivalent.	Note by Editor.	
Wheat—			
Gyonwagyi	Large yellow wheat	A short, well-formed, hard, red wheat of good quality; **Triticum sativum.**	[51]
Gyon-nyo-pu	Brown wheat	A similar, but if anything superior, wheat to No. 51.	[52]
Gyontamin-kyouk	Cooked rice wheat	A very inferior long rice-like wheat, badly formed or injured through having been cooked.	[53]
Millet (*Lu*)—			
Luwagyi	Yellow Lu	Three forms apparently of **Paspalum scrobiculatum.**	[54]
Luchinma			[55]
Lupyu	White Lu		[56]
Millet (*Sat*)—			
Sat chaung	Brown Sat	Very red forms of **Setaria italica.**	[57]
Sat ni	Red Sat		[58]
Satwa	Yellow Sat	**Setaria italica,** ordinary form.	[59]
Sat			[60]
Millet (*Pyaung*)—			
Pyaungpyu	White Pyaung	Forms of **Sorghum vulgare.**	[61]
Pyaungwa	Yellow Pyaung		[62]
Pyaungni	Red Pyaung		[63]
Pyaungchaung	Brown Pyaung		[64]
Pyaungnet	Black Pyaung		[65]

[NOTE.—The names given above may be open to some doubt as to their absolute accuracy, since no botanical specimens accompanied the samples, and, without a large museum of grains to compare, there must always be a certain amount of mistakes. *Pyaungneh* is the form of **Sorghum** generally known as **S. cernum.** Along with that sample the writer found 20 or 30 seeds of the pulse **Glycine Soja.** Much doubt exists as to the home of that pulse. **Mason** mentions it among his Burmese plants, but gives it no Burmese name. It would be interesting to know to what extent it is grown and whether it possesses a pure Burmese name, that is to say, a name that could be shown not to be a modern adaptation or descriptive word that might have been coined a year or 50 years ago.]

Memorandum from the Officiating Deputy Commissioner, Myadaung, to the Commissioner, Northern Division, Mandalay,—No. 929—58R., dated 13th June 1888.

REFERENCE: His endorsement No. 96—21, Revenue Department, dated Mandalay, 8th March 1888, and subsequent reminders.

Three kinds of Coix—one cylindrical and two globular—and two kinds of millet have been received from the Kachin Hills near Minbu, and samples of them are herewith forwarded with the names in English and Burmese attached. With reference to paragraph 3 of Dr. Watt's letter No. 50-118-25, dated Simla, 22nd December 1887, I have the honour to reply—

(*a*) The plant is not usually cultivated, but found wild. The cylindrical form was specially planted by the Kachins for their own use. It can be planted like paddy on the hill clearings on any place where elephant grass grows;

(*b*) Children collect the wild plant at times for food and for ornamental purposes;

[66] [67] [68] (*c*) Grey and smaller globular seeds are called *Kyeik pouk pouk*, the black and larger seed *Kyeik kouk nyin*. The cylindrical grey seed is called *Kyeik she si*.

Hence the nomenclature appears to be more derived from the size of the seed than from the colour.

(*d*) Cylindrical seeds are found grey, but not black.

(*e*) No sayings or proverbs are known about the plant.

(*f*) A limited quantity might be obtained by inducing the Kachins to cultivate the plant, at, say, R4 per basket.

[69] [170] With regard to paragraph 5 of the letter, the vernacular names of millet are *Tsatwa* or yellow *Tsat* and

Tsat mè or black *Tsat*.

Both are planted on hill clearings in small quantities for food.

There is no wheat now grown in this district, but a good deal of maize. Wheat was formerly grown.

[NOTE.—The specimens above are No. 66, a white soft-shelled and furrowed form of **Coix lachryma** of the cultivated type; No. 67, a very large black hard form without the basal swelling but furrowed. From the opinions formed after examining a large collection of Coix, I should be disposed to view this as either imperfectly cultivated or an escape from cultivation. No. 68 is the variety of **Coix lachryma** known as **stenocarpa**, and which has been spoken of as the cylindrical grain; No. 69 is the millet **Setaria italica**; and No. 70 probably **Panicum miliaceum.**]

From W. T. HALL, Esq., C.S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products with the Government of India,—No. 268—17 A., dated 24th July 1888.

In continuation of my letter No. 580—17 A., dated the 25th April 1888, and with reference to your letter No. 171—118-14 S., dated the 7th May 1888, to the Under-Secretary to the Government of India, Revenue and Agricultural Department, regarding the samples of wheat from Kyauksè district, Upper Burma, I have the honour to inform you that the Deputy Commissioner now reports that there is only one crop of wheat in Kyauksè which is sown in November and reaped in April. This is no doubt correct, and the account given first was inaccurate.

From W. T. HALL, Esq., C.S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products to the Government of India, No. 309—17 A., dated 26th July 1888.

In continuation of my letter No. 715—17 A., dated the 28th May 1888, I have the honour to forward herewith samples of two kinds of Coix grown in the Tharrawaddy District in Lower Burma, called in the Karen language *Bèma* and *Bèkwa*. [71] [72]

[NOTE.—No. 71 is **Coix lachryma**, *var.* **stenocarpa**—the short-bellied form. No. 72 is a very much superior form of the same, longer and thinner, and therefore, more likely to prove useful for ornamental purposes.]

From—W. T. HALL, Esq., C.S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products to the Government of India, No. 631—17 A., dated 30th August 1888.

In continuation of my letter No. 309—17 A., dated 26th July 1888, I have the honour to enclose a statement giving such information as is available concerning Coix. The plant is not known in Myingyan, Minbu, Mandalay, Shevebo, Bhamo, Meiktila, Yamethin, Pyinmana, Ye-u, and Lower Chindwin Districts.

2. I, at the same time, send extracts from letters from District Officers giving such information as is available, regarding the different kinds of wheat and millets grown in each district in Upper Burma.

For the tabular statement see the next and subsequent pages.

Information regarding Coix Seed.

District.	(*a*) Is the plant cultivated or wild?	(*b*) If cultivated, is the globular form grown as an article of food or only for ornamental purposes?	(*c*) Are the two forms, globular and cylindrical, known by separate vernacular names; what are these names?	(*d*) Is the cylindrical form ever found of a grey or black colour as is the globular?	(*e*) Are there any sayings or proverbs about the plant?	(*f*) How much might be furnished annually of the cylindrical seed, and at what price?	Remarks
Bassein . .	Cultivated and wild.	Grown both for ornamental purposes and as an article of food.	Globular kind—*Bah-thi-kto* (Karen). Cylindrical—*Bah-kye* (Karen). Burmese name for all kinds is *Kyeit.*	Cylindrical kind is always white.	Not known.	The plant is very prolific. An almost unlimited supply might be produced.	Though no large quantities are available now, if a demand were to arise all varieties would be cultivated largely.
Henzada . .	1. Cultivated . .	...	1. *Baiphataw* (Karen); *Kyitshe* (Burmese)—long coix.	...	...	1 & 2.—Obtainable in very small quantities, valued at from R3 to R4 a bushel.	
	2. Cultivated . .		2. *Baikula* (Karen); *Kyeit-pu* (Burmese)—round coix.				
	3, 4, and 5. Grow wild and are globular.	...	3. *Baiphaw, phaw* (Karen); *Kyeitwa* (Burmese)—yellow coix.	...	...	3.—Very scarce; value R2 a bushel.	
			4. *Baila-baila-baithi kalo* (Karen). *Kyeitwa, Kyeitpya, Kyeitsin* (Burmese)—yellow coix, blue coix, green coix.	...	...	4 & 5.—More plentiful than the other varieties, former valued at 8 annas a bushel, the latter at 4 annas a bushel.	
			5. *Baithu* (Karen). *Kyeit-nga Kyeik* (Burmese)—black coix.				

Note.—The specimens referred to above have not been received.—[*Ed.*]

District.	(*a*) Is the plant cultivated or wild?	(*b*) If cultivated is the globular form grown as an article of food or only for ornamental purposes.	(*c*) Are the two forms, globular and cylindrical, known by separate vernacular names; what are these names?	(*d*) Is the cylindrical form ever found of a grey or black colour as is the globular?	(*e*) Are there any sayings or proverbs about the plant?	(*f*) How much might be furnished annually of the cylindrical seed, and at what price?	Remarks.
Thongwa . .	Both forms grow wild—the globular form in abundance.	Both forms are cultivated. One globular variety, called by the Karens *Pe*, is grown as an article of food only and is softer than that called by Karens *Ber*, which is used for ornamental purposes. *Berwaithu* is a smaller edible species.	Burmans call the plant *Kyeit*, the Karens *Ber*. Globular varieties are known by the following names:— *Berthiklo, Bermu, Berliti, Berwaithu.*	Karens say the cylindrical kind is not found black.	The Karens have many sayings about the seeds in general but none as to any particular form. These sayings relate to the beauty of the form, &c.		Note.—The cylindrical black grain alluded to in the remarks (*d*) from Upper Chindwin has not been seen by the writer. This is the only mention of such a form, and specimens, if possible, should be procured.—[*Ed.*]
Kyauksè . .	Not cultivated. Grows wild to a small extent.	Not used for any purpose.	Only the globular form is found. *Kyeit* (Burmese).				
Upper Chindwin	Globular form cultivated; cylindrical form grows wild in the Kubo valley, and above Homalin. It is used for ornamental purposes only.	Globular form cultivated as an article of food and for making beer.	Globular *Pyaukthi* (Burmese). *Sho-ishlo* (Chin). Cylindrical *Kyeit* (Burmese). *Meeni* (Chin).	Cylindrical variety is of two colours—black and greyish white.	Not known.	As the plant grows wild in the Upper Valley, a good supply could probably be obtained at a moderate price	

Information regarding Coix Seed—continued.

District.	(*a*) Is the plant cultivated or wild?	(*b*) If cultivated, is the globular form grown as an article of food or only for ornamental purposes?	(*c*) Are the two forms, globular and cylindrical, known by separate vernacular names; what are these names?	(*d*) Is the cylindrical form ever found of a grey or black colour as is the globular?	(*e*) Are there any sayings or proverbs about the plant?	(*f*) How much might be furnished annually of the cylindrical seed, and at what price?	Remarks.
Pagan in Chin Hills west of Yaw.	Both forms cultivated, the globular largely.	Globular is grown as a food grain and also for the manufacture of beer.	Known by one name *Kyeit* or *Kalithi*.				Note.—The remark that the cylindrical form will grow [at Myadaung] wherever there is elephant grass (? *Kaing*) would point to its not requiring to be submerged as is the case with most of the forms of **Coix lachryma**—an idea that favours the impression of its being possibly a distinct species.
Ruby Mines	No cylindrical Coix in this district, but there is in Momeit and Taungbaing territory.	(*a*) This Coix grows wild: the seeds are used for rosaries. (*b*) Palaungs cultivate this Coix to make offerings with.	(*a*) Globular seed hard called *Mahochit* in Shan. (*b*) Globular seed large white called *Malwe Rantaik*.				
Myadaung	Plant not usually cultivated but found wild. Cylindrical form, however, is planted by Kachins on hill clearings; it will also grow wherever there is elephant grass.	Children collect the wild plant for food and for ornamental purposes.	*Kyeit pouk pouk*—grey small globular seeds. *Kyeit kouk anyuise*, black larger seeds. *Kyeit she se*—cylindrical grey seed. Nomenclature is derived from the size of the seeds and not from the colour.	Cylindrical are grey, and not black.	..	A limited quantity might be got from Kachins at ₹4 a bushel.	

Extract from letter No. 215—31G., dated the 1st March 1888, from the Deputy Commissioner, Myingyan, to the Commissioner, Southern Division.

* * * * * * *

2. Six distinct kinds of millet are recognised here. The names are as follows:—

Millets.

1. Sanpyaung.
2. Pyaung Shwe wa or Lunbaugyan.
3. Kouk huyin Pyaung.
4. Byu or Pyaung Kadu.
5. Pyaung ni.
6. Kyetseit Pyaung.

NOTE.—None of the specimens alluded to from this place to page 136 have been seen by the writer, and their scientific names cannot, therefore, be assigned to them.—*Ed.*

3. Only one kind of wheat is known. It is called *Gyon Gyi.*

Extract from letter No. 190—35, dated the 21st March 1888, from the Deputy Commissioner, Pagan, to the Commissioner, Southern Division.

* * * * * * *

The following millets are grown in the Pagan District.

Wheat.

Lu—**Panicum paspalum.** [See p. 127.]
Sat—A panicum with smaller grain than Lu.
Sat kyan.
Sat se.

Pyaung San **Sorghum vulgare**; a variety of wheat *gyon* is also grown in Pagan. If required, specimens and description can be furnished when these crops are in the ear; none are at present planted.

Extract from letter No. 158—1-17, dated the 20th instant, from the Deputy Commissioner, Pyinmana, to the Commissioner, Eastern Division.

* * * * * * *

Two kinds of millet are grown—

(1) *Hnan Pyoung.* [See p. 127.]
(2) *Tsat.* [See *Tsat* at pages 127 & 128.]

3. They are sown among the Indian maize* in the months of Kosone and Nayone (May and June), and the crops ripen in Wa-Tso and Wagoung (July and August). These plants would not thrive in low-lying ground where there is an over-abundance of water, and are therefore grown on "Yas," which are higher grounds than paddy land.

Millets.

4. *Hnan Pyaung* resembles the Indian maize, with this difference that the leaf is slightly smaller and the plant itself much taller. Its seed is as large as No. 4 shot and is round.

5. *Tsat* looks like kine grass, but is not so high as the maize plant, and has a smaller leaf than the *Hnang Pyaun.* Its seed is globular and looks like snipe shot.

6. These millets are grown for home consumption only.

7. The experiment of growing wheat in this District was tried some years ago but was a complete failure.

Wheat.

Letter No. 197, dated 25th May 1888, from the Deputy Commissioner, Yamethin, to the Commissioner, Eastern Division.

With regard to your No. 476—7-4, dated 21st instant, I have the honour to report—

Wheat is known as *Ion Saba,* but is not grown in this District.

Wheat.

* Name given in Burmese character: is therefore valueless to any person outside the limits of the province. It would be most desirable to obtain the transliteration in roman character of this and all other names which occur in the communications published in this paper. See the remark, paragraph 5, page 116.—*Ed.*

The millets are *Pyaung Hnan* (Jowar) [see p. 127], *Sat* and *Lu*, all grown in this district, the latter two in small quantities. There is also *Pyaung bu*, Maize.

Maize.

I do not know whether this is a millet; it is grown in this district, and there are minor fanciful varieties. [Presumably, this remark refers to Zea Mays—Indian-Corn. It would be most instructive to know more of that introduced plant. American in its origin and unmistakably so, it still bears names in India that would appear indigenous. Is this the case with the Burmese names? What do they mean, and are they only adaptations or modern descriptive appellations?—*Ed.*]

Extract from letter No. 14—9, dated 3rd May 1888, from the Deputy Commissioner, Upper Chindwin, to the Director of Land Records and Agriculture, through the Commissioner, Central Division.

PARA. 5. Millets and wheat are not grown in this district. Some experiments were tried last year with wheat which were only successful in one or two instances out of many.

Extract from letter No. 1—8, dated the 2nd August 1888, from the Deputy Commissioner, Lower Chindwin, to the Commissioner, Central Division.

Millets.

2. With regard to millets the following varieties are cultivated in this district :—

(i) *San pyaung*, grain like rice with no outside husk, grows to 15 feet height in good years.
(ii) *Pyaungni*, red seed, grows as high as (i). [See p. 127.]
(iii) *Wethâlimyo pyaung*, reddish globular seed, the outside husk is oblong.
(iv) *Thon-lôn byut pyaung*, the same as (ii), but white seed.
(v) *Myet kon gyi pyaung*, another variety.

NOTE.—(i) to (v) are all varieties of one species known in India as *Jowari*. They reach all about same height, *i.e.*, 15 feet in a good year.

(vi) *Pyaung bu*, Maize. [See remark above regarding this.]
(vii) *Sat*, about 3½ feet in height, yellow seeds like the seeds of Sesamum.
(viii) *Lu*, same height as *Sat*, yellowish seeds like small variety of rice. All the above cereals are extensively cultivated in this district, the soil of which seems to be especially favourable to their growth.

[NOTE.—For *Sat* and *Lu* see the determination of specimens on page 127.]

Extract of letter No. 69—9, dated the 24th April 1888, from the Deputy Commissioner, Ye-u, to the Commissioner, Central Division.

* * * * * * *

Millets.

2. There are three kinds of millet, *viz.* :—*Pyaung*, *Loo*, and *Sat*. *Payaung* is the tallest millet amongst the three. It is generally sown in friable soil about the early part of October; it is chiefly consumed by the people when rice is scarce, and is grown only as an article of food. It is of globular form and yellowish colour.

Loo.—This is sown in alluvial soil about the month of June; it grows very quickly and can be reaped 50 days after being sown. This grain is not so large as *Pyaung*, but of the same globular form and yellow colour. In case of scarcity of rice, people mix it with rice and eat it in that form.

Sat.—This is also sown in alluvial soil like the above and at about the same time; and as an article of food. The grain is not so large as *Loo*; it is the smallest millet in Burma. Ordinarily, this is not eaten by itself but is mixed with rice; whereas the first and second named millets can be eaten without mixing with any grain. Cylindrical form of millet is not known here, and wheat also is not cultivated in this district. [The cylindrical millet referred to is presumably Coix.] Millets. Wheat.

Extract from memorandum from the Officiating Deputy Commissioner, Myadaung, to the Commissioner, Northern Division, Mandalay,—No. 929—58 R., dated 13th June 1888.

With regard to paragraph 5 of the letter, the vernacular names of millet are *Tsat wa* or yellow *Tsat*. Millets.

Tsat mè or black *Tsat*. [See this same communication at p. 128.]

Both are planted on hill clearings in small quantities for food.

There is no wheat now grown in this district, but a good deal of maize. Wheat was formerly grown here. Wheat.

Extract from letter No. 7—7 L.R.A., dated 21st June 1888, from the Deputy Commissioner, Shwebo, to the Commissioner, Northern Division.

* * * * * *

2. The following millets are grown here: Millets.

(*a*) *Lu*, grown only when a bad crop of rice is expected, grown more or less over the district.

(*b*) *Hsat* of three varieties: *Hsat net*, a blackish variety; *Hsat mwe sók*, a yellowish or a coarse grain and more hairy variety.

(*c*) *Hsat kauk hnyin*, a more inferior and smaller variety under cultivation more or less over the district.

3. *Wheat.*—On enquiry I find there is no wheat cultivation now in the district, but am informed that there was in former years, and it was produced in fair quantities. The only specimen of wheat seen by me was at Monhla, the result of a successful experiment on seed sent to Father Laurent by me and from seed bought by the Father from the Commissariat Department. Wheat.

The wheat cultivation in former years was financially a failure, cultivators turning their attention to the production of the more profitable grain, such as paddy, beans, peas, gram, &c., &c. A failure.

I would ask that a book of reference be supplied on this subject.

[Perhaps the best work of this nature is *Professor Church's Food Grains of India*. The plates are invaluable and would enable district officers to recognise the majority of the food crops of India.]

Extract from Memorandum from the Deputy Commissioner, Bhamo, to the Commissioner of Mandalay.

* * * * * *

No wheat is grown in the district and only a little Indian-corn in Toungyas. Wheat.

Extract from letter No. 2—4, dated 17th May 1888, from the Deputy Commissioner, Meiktila, to the Commissioner, Eastern Division.

* * * * * *

2. Wheat is not extensively grown in this district, and I can get but one sample which I forward. Wheat.

Millets.

3. There are five kinds of millet, *viz.*:—

1. *Pyaung Shwe wa* or the golden millet.
2. „ *Ni* „ red „
3. „ *Mwai* „ grey „
4. „ *Net* „ black „
5. „ *San Pyaung* „ rice „

Samples of these are forwarded. [For the specimens see p. 124.—*Ed.*]

From W. T. HALL, Esq., C.S., Director of Land Records and Agriculture, Burma, to the Reporter on Economic Products with the Government of India,—No. 178—17A., dated the 11th September 1888.

In continuation of my letter No. 631—17A., dated the 30th August 1888, I have the honour to forward a copy of letter No. 528, dated the 4th instant, from the Conservator of Forests, Pegu Circle, with an extract from a letter from an American Missionary giving further information regarding Coix.

2. The samples from Tharrawaddy are also forwarded by parcel post.

Letter from the Conservator of Forests, Pegu Circle, to the Director of Land Records and Agriculture, Burma,—No. 528, dated the 4th September 1888.

In reply to your letter No. 368 (Agriculture), dated 15th February 1888, forwarding a note by Dr. Watt on Coix seed, and asking for further information on the points mentioned in paragraphs 3 and 4 of his note, I have the honour to forward samples of three kinds of Coix grown by Karens in the Tharrawaddy District.

These are—

[73] 1. *Beu kwa* [Coix lachryma, *var.* stenocarpa—good long form].
[74] 2. *Ben mü pado* [a remarkably short-bellied form of the above].
[75] 3. *Ben mü po* [a very short-bellied form, almost intermediate between the globular and the cylindrical conditions].

Beu (the *eu* pronounced as in French) is the Karen name for Coix generally; *Kwa* means male and *mu* female. All these varieties are cultivated and not wild; they are grown in small quantities solely for ornamenting dresses, &c., but the cultivation of the plant appears exceedingly easy, and there would probably be no difficulty in obtaining large quantities of the seed should a demand spring up for it.

The ordinary large spherical Coix lachryma is grown by the Karens as an article of food and called by them *Awbeu*, or edible Coix. The Burmese name for Coix generally is *cheik*.

2. The Reverend Mr. Bunker of Toungoo has been good enough to supply me with the following information:—

The plant called by the Burmese *cheik* is very abundant among all Karen tribes. It is called by them *Bur* and cultivated more as a luxury than as an article of food. They distinguish three varieties as follows:—

Coix.

First kind is not edible. The seed is of various colours—white, black, red, &c., and is about the thickness of a rice grain but about half an inch in length. It is used to ornament Karen dresses, bags, &c. As the plant is rich in colour it is planted among the rice to give a pleasant look to the fields, also formerly having faith in *nats*, the Karens believed that it dazzled the eyes of these enemies by its bright colour, so that they were unable to destroy the paddy.

Second kind is called by the Karens *Pay* and is edible. It is more easily grown than paddy and yields a larger outturn.

Coix.

There are two varieties of this kind, *viz.*, the white seed and the greyish coloured seed, and it is larger than the first kind, but shorter, never a spherical form. The length is about ⅛ inch. This kind has a nominal market value among the Karens, while the former has none. It is cultivated largely by the Karens for the purpose of distilling an intoxicating liquor.

A remarkable form, the stems being eaten. It would be desirable to obtain samples. Is it Coix ?—*Ed.*

Third is a much larger stalked plant than the former, though the seed is smaller than that of *Pay*, yet spherical in shape. The stalks contain a sweet juice and are frequently eaten by Karens. There are two varieties called in Karen *Tha mo* and *Tha ma*. The Burmans call both varieties *Pyaunglekouk*. I should say that it is only the stalks of the *Tha mo* that are eaten. The second kind is edible. The seeds of both kinds are about the size of the first kind mentioned, yet spherical in shape. This kind is used very extensively among the Karens for making intoxicating liquors.

Millet.

Fourth variety the Karens call *Thway* and the Burmans *Sat*. There are four kinds of this variety distinguished among the Karens by the colour and growth. The seeds are very small, about as large as a sesamum seed. This variety is also used extensively for food and sweetmeats. It is the most useful of all varieties of this class of plants and is comparatively high in price.

3. It should be noted that *Pyaunglekouk*, the Burmese name for the third species described by **Mr. Bunker** is the name given in the last edition of *Mason's Burma* to a species of **Panicum.**

Reprint of the article on Coix (Job's Tears) from the "Dictionary of the Economic Products of India."

This will be found to incorporate the important facts derived from the official correspondence received up to the 19th July and to follow the determination of the Burmese cylindrical grain recently published in *Hooker's Icones Plantarum, viz.*, that it is a variety of **Coix lachryma.**

COIX, *Linn.; Gen. Pl., III., 112.*

A group of grasses belonging to the tribe MAYDEÆ, and popularly known as "Job's Tears." Under that designation is included not merely the species of COIX but of CHIONACHNE, and probably also of POLYTOCA. The latter are not of such importance as to justify their separation in a work treating purely of economic products, and therefore the popular or rather practical view of these plants will be adopted in the following brief account of the species of "Job's Tears."

Coix gigantea, *Koen.; Duthie, Fodder Grasses, N. Ind., 18;* GRAMINEÆ.

Vern.—*Kesai*, BERAR; *Danga gurgur*, BENG.

Reference.—*Roxb., Fl. Ind., Ed. C. B. C., 650.*

Habitat.—A tall, erect, aquatic grass, with large broad leaves, found throughout the plains of India. It is distinguished from the next species by the florets of the male spikes being in threes, the central one stalked. **Roxburgh** found it in the valleys of the Circar mountains, but from his description of this and of the form named by him **C. aquatica**, it seems probable that both are referable to one species, if, indeed, they should not be treated as varieties of **C. lachryma.**

It seems probable also that **C. gigantea** and **C. aquatica** are the wild states of the cultivated plant, **C. lachryma.** At all events, no one seems to have observed them under cultivation, and thus, while the grains are not apparently eaten, the other properties of **Coix lachryma** are applicable to the above.

C. Kœnigii, *Spreng.; Duthie, Fodder Grasses, 19.*

Syn. for CHIONACHNE, *R. Br.*; BARBATA (the COIX BARBATA, *Roxb.*)

Kurz in his report on Pegu refers to this plant under the Burmese name of *Kyaip*. It is also known in India, where it bears the following vernacular names: *Gurgur*, BENG.; *Bhus, kirma-giláram gadi*, CHANDA; *Kadpi*, BALAGHAT, C. P.; *Varival*, MAR.; *Ghella gadi*, TEL.

FODDER. **Fodder.**—Duthie says that in Balaghát in the Central Provinces, it is said to be used as fodder when in the young state. Roxburgh, however, remarks that, owing to its coarse nature, cattle do not eat the grass.

Coix lachryma, *Linn.; Duthie, Fodder Grasses, 18.*

JOB'S TEARS.

Syn.—C. ARUNDINACEA, *Lamk.*; LITHAGROSTIS, LACHRYMA JOBI, *Gærtn.*

Vern.—A recent correspondence between the Government of India and the various provincial Governments has brought to light new and interesting information regarding this plant. It has been shown that Coix is much more extensively cultivated than was formerly supposed, and that there exists a very extensive series of wild and cultivated forms of Job's Tears, which the writer has placed under the above species. Should this be proved incorrect, a certain redistribution of the vernacular names, here attributed to the various species of Coix, would become necessary. One of the most remarkable of the forms of **Coix lachryma** has been figured in the last part of *Hooker's Icones Plantarum, Pl., 1764*, as **C. lachryma, *var.* stenocarpa**, and an effort, in the following remarks, will therefore be made to indicate, as occasion occurs, the vernacular names that more properly belong to that form. *Sankrú*, HIND.; *Gurgur* or *kunch*, BENG.; *Jargadi*, SANTAL; *Kassai-bija*, BOMB.; *Ránjondhala, rán-makkai*, MAR.; *Jondhali*, POONA; *Sánklu* (Sabathu Hills), PB.; *Dabhir* (Mount Abu), RAJ.; *Sankru* (according to **Royle**), *baru* (at Sáharanpur), N.-W. P.; *Ganddula, garun* (Bundelkhand), *kasei, galbi, gadi* (Chanda), *galu* (Seoni), *gurlu* (Balaghat), C.P.; *Sohriu* (Khásia and Jaintia Hills), ASSAM; *Jargadi*, SANS.; *Kyeit, kalithi* or *cheik* (the white form), *kyeik-phun, sakyeik* (the edible), BURM.; *Bé* (large form), *be-ma* (the small), KAREN; *Kudhia thia* or *kudhati* (the black form), *so-tsa* (the white), and *ke-sí* or *kasi* (collective or generic name), NAGA HILLS; *Mung*, MANIPUR; *Kirindi-mana*, SING.; *Ee-jin, ee-yin*, a name used in China and Malacca.

The Latin Coix and probably the Greek Κοιξ were applied apparently by early writers to an Ethiopian palm, but according to **Theophrastus** to a reed-like plant which may possibly have been the modern Coix. It is worthy of note that the name *kasi* by the Nagas given generically to the cultivated forms should reappear all over India: thus *kasei* in Chanda, *kassai* in Bombay, *kesai* in Berar (for **C. gigantea**); and that many of the names in use in Burma should have so strong a resemblance to that word, *viz., kyeit, kyeithishe, kulésé, kalinsee, &c., &c.* It seems probable that the expression Job's Tears is wrongly applied to Coix. The Arabs have a tradition that Job used the flowers of **Inula dysenterica** to heal the sores on his body, hence according to them **Inula** and not **Coix** would be the true Job's Tears. That expression, as applied to Coix, rests most probably, however, on the shape of the grains, and **Gerarde** says "every graine resembleth the drop or teare that falleth from the eye." The very application, however, of the name Job's Tears would suggest an ancient cultivation; but the fact that in the wild state the plant yields a much larger grain than either rice or wheat may be taken as suggestive of Coix having at an early date been cultivated by the inhabitants of the countries where it was found; and it would seem as if it had been displaced from popular favour when the superior properties of other food-grains became known.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 649; Thwaites, En. Zey. Pl., 357; Dymock, Mat. Med. W. Ind., 2nd Ed., 853; Balfour, Cycl. Ind.; Hooker's Him. Jour., II., 289.*

Habitat.—Met with on the plains of India, and on the warm slopes of the hills from the Panjáb to Burma. It seems probable, as stated under the preceding species, that the forms referable to this type are mostly cultivated; they are less aquatic in character than those referred to **C. gigan-**

tea, and appear to occur at higher altitudes. They are also more stunted in growth, and the involucre (or shell around the grain) is looser, softer, and apparently always furrowed—at least this is so with all the cultivated forms.

Forms of.

THE FORMS OF JOB'S TEARS.—There are three or four well-marked forms of Job's Tears met with in India, which differ from each other in shape, colour, and degree of hardness, and in the presence or absence of grooves or furrows along the length of the hardened involucre. As to shape there are three types—a long *cylindrical* or tubular (*var.* stenocarpa), the normal *pear-shaped* condition, and a *flattened spherical* form about the size, and not unlike the shape, of the fruits of **Malva rotundifolia**, only smooth and polished.

The writer has had the pleasure to examine a large collection of samples made in Burma and Assam, and would offer the following remarks regarding these.

1st—The cylindrical form is returned as frequently cultivated, and also wild in the Pegu Divisions of Burma (in the following districts—Prome, Pegu, Hanthawaddy, and Tharawaddy); also in the Tenasserim Division (in the following districts—Amherst, Taung-ngu, Tavoy, Mergui, and Salween). It is said to be wild but not cultivated in the Naga Hills of Assam. From no other part of Assam, however, have samples of this form been received, but in the part of *Hooker's Icones Plantarum* (to which reference has been made above) it is stated that "Mr. R. Bruce of Balipara" forwarded samples to the British museum, with a note to the effect that the "involucres are known to 'the Assamese and the Míris, and called by them the *cowrmonee* or crow-bead, from the fondness of these birds for this berry.'" It would appear, therefore, that the cylindrical grain may occur in the Míri country, but up to date (in connection with the present enquiry) no information corroborative of this fact has been received from Assam, and the plant does not appear to occur in any other part of India, so that it may safely be viewed as a native of Burma, and possibly distributed into the mountain tracts of Upper Assam and Cachar. The cylindrical grain is always of a white colour, smooth, polished, not furrowed, but constricted towards both extremities, and whether wild or cultivated, is collected for ornamental purposes only, and not as an article of food.

2nd—Of the pear-shaped form there are numerous sorts, varying in size and colour—some pale and bluish white; others grey, yellow, or brown-black. They are often constricted at the base into a disk-like annulus, and in all the samples said to be collected from cultivated stock, the grains are more or less deeply furrowed, and in the slate-coloured samples the bottoms of the furrows are of a brown shade. The cultivated forms are also loose-shelled and flattened on one side, somewhat obliquely, like the smaller cardamom. The wild forms are smooth-shelled, the shell being often so thick and hard that it can scarcely be broken. The cultivated forms are frequently grey, brown, or even black, although in point of abundance the straw-white form is that most extensively met with. They rarely ever have the shining, polished appearance of the grains returned as collected from wild plants. From Assam has been received the most extensive and varied series of cultivated Coix.

3rd—Of the flattened spheroidal kind all are smooth, hard-shelled, and look like artificial beads. They are often yellow or even pink, and do not possess the disk or swelling at the base. They appear never to be cultivated, and have been sent in the greatest abundance from Burma. It seems probable these belong to a different plant from the forms described above.

It is somewhat remarkable that in all the cultivated forms the shell is loose and furrowed. These forms vary considerably as to size from that of a grain of rice or small grey pea to a haricot bean. A sample from Akyab

COIX LACHRYMA. Forms of.

is fully half an inch long, and is pronouncedly flattened obliquely with a large swelling at the base. It seems probable that these loose-shelled forms belong to **Coix lachryma** proper, while some of the smooth, hard-shelled kinds (and especially the spheroidal forms without the basal annulus) may be from **C. gigantea** or some undescribed species. Of the flattened spheroid forms sent from Hanthawaddy some are extremely pretty, are pale pink, smooth, and shining, with a natural central perforation, making them look like artificial beads. A brown sample from Akyab is so hard and shining as to closely resemble small marine shells. The Deputy Commissioner says the globular form grows wild in low marshy land and is not eaten. This may be the plant **Roxburgh** described as **C. aquatica.**

The following brief abstract of the reports received from Burma will convey some idea of the forms of Coix there met with, while it will afford the means of recording the vernacular names that are in use with reference to the various wild and cultivated plants.

PEGU DIVISION.

BURMA. Pegu.

In the Pegu District five forms exist: a large pear-shaped kind known as *cheik* or *kyeikthi* which grows wild plentifully, but is not collected either for food or for ornamental purposes. There are two forms of this, one white, the other brown grey, both are smooth, polished, and very hard. A brown edible form is cultivated—a polished grain with the characteristic furrows and basal annulus. Lastly, there are two forms of *var.* **stenocarpa,** both of which are cultivated—the one called 'male *cheik*,' long, thin, and quite cylindrical, and the other 'female *cheik*,' shorter and slightly swollen in the middle. Separate names are not given to distinguish the cylindrical from the pear-shaped forms. The best quality is said to come from the upper valley of the Pegu river.

In Hanthawaddy District some seven or eight forms exist in a wild state or are cultivated. One only is grown as an article of food, namely, a slaty brown irregular grain, of a dull colour, furrowed, and with an annulus. This is found only on the plains, is called *Kyeikthi*, and is sold for 8 annas a basket. All the others are wild or cultivated, but collected purely for ornamental purposes. One is a medium-sized steel grey seed, smooth, shining, and pear-shaped. Three are pinkish-brown, small, of the flattened spheroidal form, and the most perfect beads in the whole collection of Coix seeds before the writer. These have been lettered B. D. and E., but do not appear to bear separate names, although they are said to be "grown" by the Karens. The sample D. would most probably command a large sale in Europe, as it is of a rich colour, smooth, and polished, with an almost artificially regular perforation, and so hard that it is impossible to break the grains without the aid of a hammer. Two samples of the cylindrical seeds complete the list of the Hanthawaddy consignment of Coix. These correspond exactly to the two forms described above under Pegu, the sample marked G. agreeing with the so-called "male," and C. with the "female" form.

For European ornamental purposes these are very promising forms.

In the Prome District both spherical and cylindrical forms are said to occur, wild and cultivated. Of the samples forwarded along with the report, one is a small steel grey, furrowed and loose-shelled form, which, judging from all the other samples of Coix examined by the writer, must be cultivated, and most probably not wild. The other two samples furnished are the forms of the cylindrical described above, only that the longer form is nearly as much swollen in the middle as the shorter. The Deputy Commissioner deals in his report with a much more extensive series than he has furnished samples of. He says the forms of Coix are known collectively by the name *Kyeikthi*. The cylindrical being *Kyeikshe* (literally, long *Kyeik*); of the globular form there are names to distinguish certain recognised types thus:— *Kyeikphun*, white *Kyeik*; *Sakyeik*, edible *Kyeik*; *Pyaung*, or maize-like *Kyeik*; and *Kyeikni*, or red *Kyeik*.

COIX LACHRYMA. Forms of.

In the Tharrawaddy District the Deputy Commissioner says that all the forms are known by the Burmese name *Kyeikthi*, but that a large round edible form is known to the Karens as *Bè*, and is cultivated, while another smaller round kind is known as the *Bè-ma* (or female *Bè*) and is collected for ornamental purposes. He further forwards a sample of the cylindrical grain, and says it is known as the *Bè-kwa*.

Arakan.

ARAKAN DIVISION.

In the Akyab District the pear-shaped form is both wild and cultivated. From the town of Akyab, the Deputy Commissioner has furnished three samples of the wild plant, the seeds being smooth, polished, and very hard, especially a brown form. He states that these forms grow in the low marshy lands and are not eaten. He, however, furnishes a sample of a cultivated form obtained from Myohaung—the largest Coix grain yet examined—which fully supports all that has been stated above. It is steel grey, deeply grooved, with a loose shell and pronounced basal swelling. The Deputy Commissioner describes this as "the cylindrical form," but while it is certainly longer than the Akyab grain, it is not the cylindrical form (*var.* stenocarpa) described above, but is a monster form of the ordinary cultivated pear-shaped grain.

In the Kyauk-pya District three forms of Coix occur—two wild and one cultivated. The writer has not seen any specimens of these, yet has no reason to doubt but that they would answer very much to the types described under Akyab. One of the wild forms is larger than the other and is known as *jaisee* or *kalinsee*, while the smaller form is the *chitsee*. The edible form is also known as *chitsee*, and is both eaten and made into beer.

Tenasserim.

TENASSERIM DIVISION.

In the Amherst District both the round and cylindrical forms are grown, the former being eaten, and the latter used for ornamenting ladies' dresses. A wild round form is said also to exist. Samples have not been communicated, but the Deputy Commissioner reports that both are known as *kyeit*.

In the Shwe-gyin District no form of Coix is known.

In the Taung-ngu District it is stated that the cylindrical form grows wild, while the globular is cultivated: both are known as *kyeit*: the former is used for ornamental purposes, and the latter is grown as an article of food and for making beer.

In the Tavoy District the round and the cylindrical forms both exist, wild and cultivated; they are known as *kyeit* and *kalithi*.

In the Mergui District, and chiefly in the Palaw township, cylindrical and round Coix are both cultivated and wild. The Deputy Commissioner forwards seven samples, of which Nos. 1, 2, and 4 are cultivated, the others wild, while Nos. 3, 5, 6, and 7 are used for ornamental purposes, and No. 4 is extensively eaten. It is worthy of note that of these samples only those cultivated, *viz.*, Nos. 1, 2, and 4 have the shell or involucre furrowed—the others are smooth and shining.

(1) *Kaleik* is a dark brown or bluish black polished grain of the pear-shaped series.

(2) *Kaleik Kauk-nyin*, the same as the last so far as the appearance of the grain goes.

(3) *Kaleik Sinswè* is the narrow cylindrical grain already alluded to as "male." The so-called "female" is No. 6 of the present list.

(4) *Kaleik Pauk-pauk*.—This is the smallest pear-shaped and furrowed grain in the Burmese series. It is almost round, with an apical elongation; is pale, straw-coloured, and pronouncedly furrowed. The Deputy Commissioner says it is "used extensively as a food grain."

COIX LACHRYMA. Forms of.

(5) *Kaleik Yingwè.*—This is a very small form of the flattened spheroidal grain, of a dirty milky white colour, a little smaller than the Hanthawaddy sample marked D, but of the same shape. The seeds are less than a ¼ inch in diameter and not much more than half that size in thickness through the central perforation.

(6) *Kaleik Yaing*, the form of stenocarpa that has been described as "female," a short cylindrical grain with a central swelling.

(7) *Kaleik Kyauk* is a large white or straw-coloured pear-shaped grain devoid of surface furrows. This is the largest straw-coloured grain in the Burmese collection, as No. 4 above is the smallest. Many of the steel grey whites are quite as large as No. 7, but few of the straw-coloured ones approach it in size.

In the Salween District both the globular and the cylindrical form is cultivated, but the former exists also in a wild state. They are known in Burmese as *kyeit*, the cylindrical being *kyeithishe*, and the globular *kyeitthilon*. In the Shan language they are *Malweleitayaung*, the cylindrical and *Malweleitamun*, the globular. In Karen, *Baw-kwa* the cylindrical, and *Bowma*, the globular; also in Karenni *Kulèsè* the cylindrical and *Tabusè* the globular. Both forms are extensively grown in the Shan States, where the cylindrical is sold for R1 a bushel and the globular from 4 to 6 annas.

The following abstract of available information regarding Coix cultivation in Assam may be here given to complete this brief review of the subject :—

ASSAM.

Sir J. D. Hooker remarks : "A great deal of Coix is cultivated in the Khásia hills; the shell of the cultivated sort is soft, and the kernel is sweet, whereas the wild Coix is so hard that it cannot be broken by the teeth; each plant branches two or three times from the base, and from seven to nine plants grow in each square yard of soil; the produce is small, not above 30 to 40 fold." Mr. McCabe, the Deputy Commissioner of the Naga Hills, reports : "The Nagas of this district cultivate six varieties of Job's Tears. The generic name is *Ka-si*, and the varieties are as follows :—

"'*Sibu.*'—The seed is of a bluish grey colour and pear-shaped in form. This is a medium-sized form, with soft shell deeply furrowed with brown lines : oblique and with a basal swelling. This is smaller but somewhat like the large grain obtained from Akyab.

"'*Kerengisa-si.*'—Of the same colour as *Sibu*, but more cylindrical in shape. Hardly to be distinguished, in fact, from *Sibu*, except in being more oblique and in having a pronounced apical and basal constriction.

"'*Sipia.*'—A small grain about half the size of *Sibu*, of a russet brown colour. This might also be said to be a more regularly-formed grain, with a harder shell than either of the preceding, but not sufficiently hard to admit of its being used for ornamental purposes.

"'*Sámáprè.*'—Pear-shaped in form resembling *Sipia*, but smaller in size. This dark brown regular grain looks at first sight remarkably like some of the forms of black rice. It is about the same size and is pointed at both extremities. It is considerably like an elongated caraway.

"'*Kadátha.*'—Almost globular in form, of a mottled brown and grey colour. The most marked peculiarity of this grain is that it is dark brown like the *Sipia* form in the lower half and yellow or straw-coloured in the upper.

"'*Kasi.*'—Globular form of a light grey or yellow colour. This is the most common variety."

Naga Hills.

The Naga hill samples, examined by the writer, fully support the opinion formed on examining those from Burma,—namely, that the cultivated races have all a loose easily breakable shell, which is also deeply furrowed. None have smooth polished hard shells like the wild forms which

COIX LACHRYMA. Forms of.

are collected in Burma and other parts of India to be used for ornamental purposes. It may also be added that the average elevation of the Naga and Khasia hills may be put down at from 3,000 to 5,000 feet, whereas the smooth-shelled forms are met with chiefly in the marshes of the plains of India and Burma. The white forms of the Khásia hills are harder, more polished, and less furrowed than the cultivated white forms from any other part of India, but they still preserve the characters assigned collectively to the cultivated forms. From the Khásia and Jaintia hills two samples of Coix have been received both of the milky white kind. A large and a small grain from the latter resembles very much the small white grain obtained from Mergui (No. 4 above), only that it is a little larger. In the report which accompanies these samples it is stated that four kinds of Coix are grown in these hills, but that "none of the four are wild, all are cultivated exclusively as an article of food. The cylindrical form" (*var.* **stenocarpa**) "is unknown to the Khásias." The dark coloured forms are said to boil softer than the white, and the smaller of the two white forms "is slightly better flavoured than the larger."

Khasia Hills.

Food.—This curious grain might almost be said to be unknown to the natives of India generally, except as a weed of cultivation. To the hill tribes on the eastern frontier, however, it is an important article of food; with the Tankhul Nagas of Manipur it might, indeed, be almost described as the staple article of diet. In several districts of Burma it is also regularly grown as an article of food. **Mason** says the esculent Coix cultivated by the Red Karens is parched like Indian corn. Of the Bassein district **Mr. W. T. Hall** (*Director of Land Records and Agriculture*) reports that it is sown in gardens, the crop ripening in November. The produce sells for ₹2 to ₹3 a bushel. That officer has also forwarded to the writer numerous reports, received from the Commissioners of the various Divisions, from which the following account of the method of cultivation may be here reproduced:—"The mode of cultivation is as follows:—*1st*, before the seeds are put in the ground they are tied in a piece of cloth and watered every day for about 7 to 8 days, when whitish roots appear. They are then placed in the ground. In some cases the roots do not appear till 10 or 15 days; *2nd*, at the place where the plants are to be grown furrows are formed and the seeds are laid on the earth which is first mixed with cow's dung, afterwards the seeds are covered up with a little earth. Another method is to dig a hole where dung and decayed leaves are burnt and plant the seeds in these places. This method is considered the most successful. When the plants bear fruit and the latter becomes mature or grows white, the branches should be broken off. This will cause the plants to yield another crop and thus to last much longer." Speaking of the cultivation pursued in Akyab the Deputy Commissioner writes (of the Myohaung township) with reference to the form which he calls "the cylindrical," but which, according to the samples discussed above, is a large loose-shelled grain of the pear-shaped series:—"The cylindrical is sown by the wild hill tribes on *Kaing* land or on the slopes of hills. They do not till the land for this purpose; the seeds are thrown broad-cast, and no care is taken of them. In times of scarcity of food the cylindrical are eaten, but now they are only used as ornaments for their dresses." The Deputy Commissioner of Kyaukpyu writes regarding a beautiful hard round form which is collected from the wild plant and used for ornamental purposes. Of the cultivated forms he says this is known as *Chitsee*. "It grows in June and July and dies in November and December. The plant is 4 or 5 feet high and like a reed." But a smaller, more delicate, variety is also cultivated, which he remarks is eaten and also used in the manufacture of the small beer known as *Khanag*." He adds "The seed has to be cleaned and has the taste of maize." Of the two kinds grown he says: "The plants,

FOOD.

COIX LACHRYMA. Forms of.

however, differ widely in other respects, and I am unable to say if they belong to the same variety or not."

CHARACTER OF THE EDIBLE GRAIN.—On breaking the outer shell, a cowry-shaped grain is obtained which, Professor Church says, bears on being cleaned the proportion of 1 to 4 to the total weight of the unhusked article. The Professor gives the following analysis—

Composition of Job's Tears (Husked).

	In 100 parts.	In 1 lb.
Water	13·2	2 oz. 49 grs.
Albuminoids	18·7	2 „ 434 „
Starch	58·3	9 „ 143 „
Oil	5·2	0 „ 364 „
Fibre	1·5	0 „ 105 „
Ash	2·1	0 „ 147 „

"The nutrient-ratio is here 1 : 3·8, the nutrient-value 89." From these facts it may be inferred that the grain is not likely to prove of greater economic value in the future than it is at present to the poor hill tribes who are under the necessity of growing this cereal, since, in consequence of their imperfect agricultural system and poor soil, nothing else will grow even so successfully as Coix. Dr. Smith says "it is larger and coarser than pearl barley, but is equally good for making gruel. As it is sold for five pence per Chinese pound, it makes an excellent diet-drink for hospital patients in China." It is worthy of note, however, that from the extensive series of cultivated forms which exist, and the occurrence of a long list of names for the plant and grain in nearly every vernacular language of India and Burma, an indication is given of an ancient cultivation which may have taken its birth in China and spread through the Malayan regions into Burma and thence to Assam and to India generally. If this, on further investigation, be found to be a correct supposition, it is possible that Coix may have preceded rice and been in the plains of India abandoned in favour of the more wholesome grain. Even the wild plant has so large a grain as to favour the idea of its having been early adopted as a plant to be cultivated. This idea of distribution into India is partly supported by the coincidence of the vernacular names, and may also be accepted as receiving favour from the fact that in the Indo-Burman region the plant is met with largely in a wild state, and at the same time continues to be cultivated and exhibits a greater number of forms than occur anywhere in India proper. Indeed, Coix can hardly be said to be cultivated anywhere in India at the present day. In the Khásia and Naga Hills some five or six forms of the loose-shelled and furrowed kind are grown, but the plant is said to be rarely, if ever, met with in the wild state, while the cylindrical is reported as wild in the Naga Hills but never cultivated. Unfortunately, samples of this wild plant have not been communicated, but Mr. McCabe, who writes regarding it, must know it well from the extensive use to which it is put by the Angami Nagas amongst whom he is living. He describes it as the cylindrical grain. His words are:—"The cylindrical form is only found in the wild state and is called *sikrá*. This plant is never cultivated but is found growing on the edges of terraced cultivation, and in the small gardens in the villages. The leaves resemble closely those of the cultivated species, but the plant is smaller and the stem much tougher. The seed is used, in place of cowries, in decorating the kilts and ornaments worn by young men. The yield is not so great as that of *kasi*, and the young plants suffer from the depredations of rats." He gives an interesting saying regarding the *kasi* which would show that the tribes on the Naga Hills apparently think that the rotund form was produced from the cylindrical by cultivation. "In the beginning of the world rats brought paddy and *sikra* from Japvo Mountain. Man, on seeing these products, took the paddy for himself and

left the *sikra* for the rats." Japvo is the highest peak of the Naga system, where neither wild rice nor wild coix occur. The writer does not recollect having ever seen the cylindrical form in the Naga Hills, although he collected numerous samples of the globular; but all under such conditions as to lead him to the opinion that they were cultivated forms or at most only escapes from cultivation.

COIX LACHRYMA. Forms of.

Medicine.—In some parts of India medicinal properties are assigned to the grain, as, for example, by the Santáls, who affirm that "the root is given in strangury, and the menstrual complaint known as *Silka*" (*Rev. A. Campbell*). Dr. Dymock says the *Kassai-bija* is used as a diuretic.

MEDICINE.

Domestic Uses.—In many localities the wild, hard, dry, spherical grain is extensively used by the aboriginal races for ornamental purposes. Necklaces of these seeds are frequently worn, and baskets and other ornamental articles are occasionally decorated with them, especially those made in the Nepal Tarái. The Karens cover their dresses with the narrow cylindrical form in embroider-like designs, and the Angami Nagas construct elegant earrings in which a rosette of these seeds surrounds a greenish beetle wing. The various grains which we have in the present article treated of popularly as forms of Coix or Job's tears, seem to stand a good chance of coming into use in Europe in the construction of artificial flowers, laces, bugle-trimmings, and other such purposes for which glass beads are now used, and possibly also in Catholic countries for the manufacture of Rosary beads. If found capable of being dyed a deep black colour, there might be an extensive demand for them, since they would be much more durable than glass. During the late Colonial and Indian Exhibition, several merchants, especially from France, enquired after seeds suitable for the above purposes. The writer was not able at the time to furnish these gentlemen with samples of the cylindrical seed to which repeated reference has been made above, but he gave them samples of the ordinary edible pear-shaped form. They seemed to think there might be some prospect of even that form coming into use. On being shown the Karen ornamented dresses they professed a firm conviction that the cylindrical grain would find a ready sale. This led the writer to show these garments to **Mr. W. T. Thiselton Dyer**, Director of the Royal Botanic Gardens, and in consequence a requisition was in due course forwarded to the Government of India asking that a thorough investigation should be instituted. The greater part of the information contained in the present article is the result of the enquiry now in course of being carried out. Specimens of the cylindrical grain and the plant yielding these were early furnished by the Government of Burma, and were at first identified as **Polytoca Wallichiana**, but have since been determined as **C. lachryma** *var.* **stenocarpa**. Subsequently, numerous samples of Job's tears, from every district in Burma, were obtained, and it has transpired that of the spherical form there are several small hard grains which seem quite as likely to find a market in Europe as the cylindrical. At the Exhibition only the coarser loose-shelled edible form was shown, but there would seem every prospect that the wild forms specially collected by the hill tribes of Burma for decorative purposes are those which should be offered as most suitable for the European market. Along with these the cylindrical form would afford the manufacturer of laces, &c., a choice of two forms which might be elegantly combined.

DOMESTIC. Necklaces. Earrings. Artificial flowers. Laces. Bugle-trimmings. Rosary beads.

PRICE.

Price of Coix Grain.—This has been variously estimated at from 8 annas to R4 a basket, but it seems probable that were a regular demand to arise, a fixed rate would soon be established, which would probably rule considerably below that of rice. It would have, however, to be discovered whether the hard forms could be cultivated without losing their characters which recommend them as decorative articles. The writer has offered the suggestion that some of these may be the produce of a distinct species from that of the true Job's tears (**Coix lachryma**),

COIX LACHRYMA. DOMESTIC.

and if so it might be found possible (as with the cylindrical) to cultivate them without softening the pericarpium or involucre. The cultivation of the wild walnut or of the hazelnut distinctly softens the shell, and were this to happen with the forms of Job's tears recommended above, their merit would to a large extent be destroyed. On the other hand, the price would be greatly lowered were the plants found capable of being cultivated without losing their hard glossy outer covering. At present the plants that yield these beads are abundant in Burma, and perhaps also in lower Nepal, to such an extent that no fears need be entertained of the demand, for some time to come, exceeding the supply.

Memorandum by the Reporter on Economic Products, to the Secretary to the Government of India, Revenue and Agricultural Department.

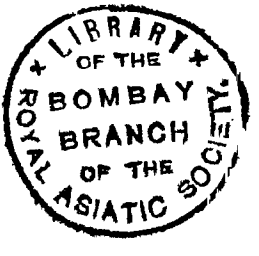
CONCLUDING REMARKS.—It is believed the present note will be found to supply all desirable information regarding the forms of Coix met with in Burma. Should facts of interest be brought to light regarding the Coix grain in other provinces, a supplementary paper may have to be issued. Regarding the Millets and Wheat of Burma it seems highly desirable that further inquiries be prosecuted, and samples of the grains and botanical specimens of the plants be furnished to allow of their determination. When this has been done, material will have been collected sufficient to justify the issue of a separate note on that subject. The writer would desire special attention to the remarks regarding **Glycine Soja** pulse (p. 128) and to **Zea Mays**—Indian-corn (p. 134).

The specimens communicated to the writer along with the correspondence here published have been poisoned with a saturated solution of corrosive sublimate so as to preserve them from the attacks of insects. They have also been numbered according to the marginal serials on the foregoing pages. They might now be forwarded to the Secretary of State for communication to Kew in continuation of former letters on this subject. It seems highly probable that to develope a future trade in these grains half maund samples of the more hopeful forms would have to be procured. The parenthetic notes by the writer will be found to indicate these, but Nos. 11, 24, 25, 27, 29, 30, 44, 47, and 48 may be specially mentioned.

[Quantities required.]

GEORGE WATT,
Reporter on Economic Products.

Simla, December 28th, 1888.



VOL. I.; PART I. (No. 11); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

HISTORY OF YAMS.

DIOSCOREA, *Linn.; Gen. Pl., III., 742.*

History of Yams.—Modern usage has assigned to the tuberous roots of the various cultivated species of **Dioscorea** the name of Yam. It is generally stated that Yam is derived from a West Indian word, or an American word, coming through the Spanish and Portuguese *inhame* and the French *igname*. Thus, **Purchas**, in his *Pilgrimage* (published in 1625), says:—"There are great stores of *Iniamas* growing in Guinea." So also **Godinho de Eredia** (*L'Inde Meridionale, et le Cathay*, 1613) remarks:—"Moreover, it produces great abundance of *inhames*, or large subterranean tubers of which there are many kinds, like the *camottes* of America, and these *inhames* boiled or roasted serve in place of bread." The *inhomes* alluded to (according to most writers) are the yams of the present day, the word "Yam" being a consequence of the Anglo-Saxon spirit of brevity, and *camottes* is generally accepted as sweet-potatoes. On the other hand, **Ramusio** (*Vol. I., p. 117, Ed. 1613*) may probably be referring to the same root when he remarks—"The root which, among the Indians of Spragnuola Island, is called *Batata*, the Negroes of St. Thomé call *Igname*, and they plant it as the chief staple of their maintenance; it is of a black colour, *i.e.*, the outer skin is so, but inside it is white and as big as a large turnip with many branchlets; it has the taste of a chestnut, but much better." In 1596 **John Huyghen van Linschoten** visited India, and, during a residence of some years, collected material for a most instructive book of travel, which was ultimately published in 1596. In that work he describes the people of India from the mouth of the Indus to that of the Ganges, and passing round the coast he extends his narrative to China and Japan. Very little escaped his observation; social customs as well as agricultural and industrial methods are each dealt with, and cultivated and wild products come in for the most accurate and careful description. Among other things he was, for example, the first to describe opium, and his account of the drug might be read as that produced by a nineteenth century author. The opinion of so valuable an observer on India with reference to the origin of "Yams" is, therefore, of no small importance. There can be little doubt that 300 years ago **Dioscoreas** of various species were regularly cultivated, but **Linschoten** draws a comparison between what he calls "*Iniamos*" and "*Batatas*." He speaks of them as "fruits"—a mistake made by all early writers, and which, indeed, has not been completely era-

DIOSCOREA.

dicated from popular fancy even at the present day—the words vegetable and fruit being often synonyms or wrongly used. Speaking of yams, however, **Linschoten** says; "These Iniamos are as bigge as a yellow roote" (carrot is meant), "but somewhat thicker and fuller of knots and as thicke on the one place as in the other, they grow under the earth like earth Nuts, and of a Dun colour, and white within like earth Nuts but not so swéete. The Batatas are somewhat more red of colour and of fashion almost like the Iniamos but sweeter, of taste like an earth Nut. These two fruits are verie plentiful, specially Iniamos, which is as common and necessarie a meat as the Figges" (he alludes here and throughout his work to 'Plantains,' which by mistake was translated 'Figges'), "they eate them for the most part rosted, and use them commonly for the last service on the boorde, they sieth them likewise in another sort of porrage, and sieth them with flesh like Colwartes or Turnops, the like doe they with Batatas." Now to remove all suspicion of the Indian so-called Iniamos, which were, 300 years ago, so "verie plentifull" and "necessarie" as plantains to the people of the west coast of India, a further quotation may be given from **Linschoten**, where he returns again to the subject of Iniamos. Speaking of the Azores he writes: "They have likewise in that island a certaine fruite that groweth under the earth, like Radishes or other roots, but the plants are trees like vines but different in leaves, and groweth longwise upon the grounde; it beareth a fruit called Batatas, that is very good, and is so great that it weigheth a pound, some more, some lesse, but little esteemed, and yet it is a great sustenance and foode for the common sort of people. It is of good account in Portingall, for thether they used to bring it for a present, and those of the Ilande by reason of the great abundance doe little esteeme it." Now, whatever may have been the *Batatas* as distinct from the *Iniamos*, one point is certain—neither can for a moment be supposed to have been Aroids. They were "vines" with leaves of a peculiar form (a remark that suggests the striking foliage of most **Dioscoreas**), and they were "vines" so large that he pronounced them "trees like vines." The use of that word "trees" almost precludes the idea of an **Ipomœa** (or **Convolvulus**), and the habit of creeping on the ground gives weight to the supposition that by Batatas he meant simply another form of Iniamos, the more so since the natives of India and of many other countries regularly allow one or two species of yam (or **Dioscorea**) to grow along the ground instead of affording them the means of twining. The sub-woody stems of most **Dioscoreas** might fairly well be viewed as admitting the expression trees, whereas that word would be quite inapplicable to the sweet-potato. One can hardly presume **Linschoten** to have failed to specialise the foliage if it had (as in the case of the sweet-potato) a resemblance to a plant with which he must have been quite familiar—the **Convolvulus**. It is much more natural that he used the word Batatas because that word had just then reached Europe. He evidently preferred to adopt words known in Europe to giving the native names; had he mentioned the Indian vernacular names also instead of using only the foreign words—Iniamos and Batatas—much of the confusion that now exists would have been saved. **Dr. Paludanus**, in a foot-note to **Linschoten's** account of yams (or yams and sweet potatoes), says: "Iniamas were this year brought hether out of Guinea as big as a man's legge and all of a like thickness, the outward part is dun-coloured, within verie white, rosted or sodden they are verie pleasant of taste, and one of the principal meates of the Black [?Moores]." In 1597, the very time **Paludanus** wrote this note, **Gerarde** was experimentally cultivating the sweet-potato in his garden in Holborn, London. **Paludanus** appears to be alluding (as he affirms) to the yam and not to the sweet-potato, but there is every probability that for a time Iniamas and Batatas were viewed as different kinds of the same tuber, at least until the independence of the plants that yielded them had been discovered. In the passage quoted from **Ramusio**, Batata and Igname are said to be synonymous. Moreover, there is nothing to show that the

DIOSCOREA.

sweet-potato is indigenous to the Azores. If, on the other hand, it be admitted to be a native of America the sweet-potato at the date referred to by Linschoten could not have become so abundant in the Azores as to be little valued by the people. We must, therefore, either suppose the Batata of the Azores was a form of Yam or that **Ipomœa Batatas** is a native of that group of islands (in mid-Atlantic and in the latitude of Spain), while the other known home of the plant is in tropical South America. As far as can be made out the sweet-potato, however, is a native of South Brazil and Chili only; but there are various yams known at the present day so sweet as to be often described as scarcely distinguishable from the sweet-potato (Conf. with **D. aculiata**). May not these have been the Batatas of China and Japan which many authors allude to as in a measure establishing an Asiatic as well as an American origin for the sweet-potato? At all events, Linschoten's description of his Batatas as being like the Iniamos "but sweeter of taste" and "more red of colour," &c., agrees far more with some of the purple-coloured yams than with any known sweet-potato. If this view be accepted the puzzle (regarding *rukt álu* being a Sanskrit name for the sweet-potato), which seems to have perplexed **M. A. deCandolle**, is at once explained. The red-coloured *álu*, which is also the sweetest of all yams, was at once compared with the modern or introduced sweet tuber until *rukt álu* became a name for the sweet-potato. (*Conf. with p. 154.*) The writer has, however, failed to find any author who, under that name, alludes to the Arum (**Amorphophallus campanulatus**) as stated by **Adolphe Pictet**. **Roxburgh** refers to the two chief forms of sweet-potato—the red and the white. To the former he gives as the Bengali name in use in his day the compound of *Lál-shakar-kandá-álú* or the red-sweet-arum-like-yam. This translation assumes the interpretation of "*álú*" as equivalent to "yam," and gives "arum-like" as the English for "*kandá.*" As a matter of fact, *kandá* is a Sanskrit name chiefly assigned to **Amorphophallus campanulatus**, so that the **Roxburghian** Bengali name would seem to be a combination of all the resemblances probably suggested to the mind of the first possessor of a sample of this valuable new tuber. Moreover, although called a Bengalí name for the plant, it is more a combination of Hindustani and Sanskrit words, and is not, strictly speaking, Bengali in its origin. There is no Indian name for the sweet-potato that has any stronger claim to being original and specific in its nature, so that there seems no doubt as to the sweet-potato being a modern introduction into India, and most probably considerably after the date of **Linschoten's** visit to the Portuguese possessions on the western coast. The name BATATA gave origin to the word POTATO, and there seems no reason for doubting but that both these terms should have been assigned to the SWEET-POTATO and not to the tuber which is now known as THE POTATO. The latter tuber was taken to Europe *after* the sweet-potato, and in the words of **Yule** and **Burnell** (*Glossary of Anglo-Indian Terms*) may be said to have robbed it of its name. This is more than an interesting historic fact. The frequent allusion to the *inhames* being used "in place of bread" suggests the possibility of the sweet cassava (**Manihot Aipi**) being the plant referred to in such passages; and if so the European form of the word (yam) may have been applied to the wrong plant. Thus sweet-potatoes, cassava, and yams may be accepted as confused with one another in the writings of early travellers; and, indeed, the literature of even the potato has to some extent got mixed up with that of the above allied tubers. A similar confusion exists in India. The potato and sweet-potato are undoubtedly modern introductions, but there are many wild species of **Dioscorea** scattered over the whole of Peninsular India, some peculiar to the hot, damp, tropical plains, others to the drier tracts, while a third set ascend to temperate regions and are met with throughout the Himálaya at altitudes up to 9,000 feet above the sea. That being so, the presumption may be admissible that most of the forms of yam met with under cultivation in India are probably also indigenous,

DIOSCOREA.

even though in some cases they are not now known in a wild state. The name *álú* by universal modern acceptance is given, however, to the potato, and that name is by no means a recent word to Indian classical literature. It can be traced into some of the early Sanskrit works. It is there applied to a farinaceous tuber—perhaps to several such tubers—being, in its earliest meaning, generic more than specific. We have no alternative, therefore, but to assume that the potato on being brought to India received an ancient name, and further, that the superior properties of the introduced tuber gradually displaced the indigenous one from public favour. According to **Professor Wilson**, and more recently to **Yule** and **Burnell**, the *álú* of early Indian classics was an aroid and most probably **Amorphophallus campanulatus** (see *Dict. Vol. I.*, **A.** 996). But **Amorphophallus** is a distinctly tropical genus of **Aroideæ** and does not extend beyond the Himálayas. If therefore *álú* was originally given to an aroid it may have denoted a species of **Arisæma** (to some extent an extra-tropical genus), but in India the members of that genus are all poisonous and none of them are cultivated.* **Mr. John Crawford**, in a most valuable paper on the *Migration of Cultivated Plants in reference to Ethnology* (*Selections in the Agri.-Hort. Soc. of India, Vol. I., New Series, 1868, p. 15*), says, that the word *álú* had a generic meaning with the Hindús of Upper India, being equivalent to *kalangku* with the Tamil-speaking people and *ubi* with the Malayan nations. He is also disposed to view *álú* as having been originally applied to an aroid and "not to the yam with which as an extra-tropical people the Sanskrit-speaking race must have been unacquainted." While not prepared to dispute an opinion held by so many high authorities, the writer may be permitted to say that he would be more disposed to accept a **Dioscorea** as having been the plant to which the word *álú* was applied when it first received (and probably in India) a restricted or specific meaning. But even the idea of "an extra-tropical people" can have little weight, since various species of **Dioscorea** are temperate Himálayan plants and are distributed even to Afghánistan. **Aitchison**, for example, found **D. deltoidea** in low scrub from 7,000 to 8,000 feet in altitude, near Shálizan in Afghánistan.* Unless *álú* be taken as a form of *olla* (a Sanskrit name for **Amorphophallus**, from which the modern Bengali term *ol* is derived), there are probably no other references in Sanskrit literature to *álú* that could with any degree of certainty be accepted as alluding to an aroid. But the question may fairly well be asked, as against the argument resting on the Sanskrit-speaking people having been "extra-tropical"—how did the tropical **Amorphophallus campanulatus** come to get its early Sanskrit names? There are several well-known Sanskrit synonyms for that aroid, such as *surana, kanda,* and *arsaghna.* In none of the modern languages of India does **Amorphophallus** bear a name traceable to *álú,* while the Sanskrit synonyms given above clearly afford many colloquial names. Thus the plant is the *ol* in Bengal,† *suran* in Bombay, *kanda* in the Deccan, and in Madras (among the Telegu-speaking people) that is also one of its names. *Zamin khand* is a Panjáb name apparently for the tubers of **Dioscorea bulbifera.**

The writer is aware that one cultivated aroid (*viz.*, **Colocasia antiquorum**) is in some dialects of India called *álú* or rather *kachálú,* but its Sanskrit name is *kachchi* or *katchú,* and there is much in favour of the opinion that the word *álú* is a modern addition to the Sanskrit name of that plant. If the *kachú* be the *álú* of Sanskrit writers, it is somewhat significant that it should have carried with it, not the name *álú,* but *kachú,* from which, through the Arabs and the Egyptians, the Greeks probably obtained their *colcos* or *kulkas* (Conf. with **Colocasia**, *Dict. Vol. II.*, **C. No. 1731**), and ultimately the name **Colocasia** itself. **Mr. Baden Powell** mentions a

* Conf. with **Dr. D. Prain's** remarks on page 154.

† Conf. with **Dr. Dymock's** remarks on page 154.

DIOSCOREA.

curious fact, namely, that in the bazars of the Panjáb the tubers of **Dioscorea deltoidea** are viewed as the *kachálú* collected from old plants. On the other hand, in nearly every dialect of India, *álú* is the generic name for the **Dioscoreas**, the species being indicated by qualifying or descriptive pre fixes. It is noteworthy also that the Tamil name *kalangu* and the Malay name *ubi*—the synonyms of *álú*—should now be applied to **Dioscoreas**, while so accurate a writer as **Ainslie** should give the potato the name *Wallarai-kilangu* (*i.e.*, English Yam). He tells us that at the time he wrote (1813) the potatoes had just then been introduced into Madras. **De-Candolle** is doubtless in error (in assuming the correctness of **Roxburgh** and **Piddington**) when he says there are no Sanskrit names for the species of cultivated **Dioscoreas** (*Origin Cult. Plants, p. 77*). **Dr. U. C. Dutt** (in his *Materia Medica of the Hindus* compiled from Sanskrit Medical Works), gives the following Sanskrit names:—*Dandálu* (**Dioscorea elata, Linn.**); *Madhválu* (**D. aculeata**); *Pindálu* (**D. globosa**); and *Raktálu*, (**D. purpurea**). Throughout the whole of **M. deCandolle's** most instructive work, **Piddington's** popular Index to Indian Names of Plants has unfortunately been accepted as a standard authority. This has in many cases led to what the writer is constrained to pronounce serious consequences. To some extent, in the absence of Sanskrit names from that Index, many economic plants have been excluded from consideration as Indian. Thus, speaking of the absence (or rather supposed absence) of Sanskrit names for the cultivated **Dioscoreas**, he says:—"This last point argues a recent cultivation, or one of originally small extent in India, arising either from indigenous species as yet undefined or from foreign species cultivated elsewhere. The Bengalí and Hindu" (*sic? Hindústani*) "general name is *álú* preceded by a special name for each species or variety; *kamálu*, for instance, is **Dioscorea alata**. The absence of distinct names in each province also argues a recent cultivation." A reference to the vernacular names given under each species (in the pages which follow) will show that even this last conclusion is not well founded. In most of the languages of India there are several names for the species (wild and cultivated) of **Dioscorea**—every shade of cultivated form frequently having its distinctive name.

It may be admissible that most of the cultivated plants which the invading Sanskrit-speaking people found in Hindústan, and which were unknown to them before their arrival in India, received from them Sanskrit names (or Sanskritised forms of their aboriginal names), or had old generic Sanskrit names in time restricted or specifically applied to them. It would, indeed, be unsafe to assume that the pre-Aryan people of India did not possess some wild or cultivated plants of value which were unknown to their conquerors. The Santals and other aboriginal races have names for most of the **Dioscoreas** which have no connection with the Sanskrit names for these plants. Thus the **Rev. A. Campbell** tells us that **D. bulbifera** is known to the Santals as *Piska*, and that its tubers are considered a "great delicacy" (in Bombay that plant is known as *mar-páshpoli*). **D. glabra**, **Mr. Campbell** also says, affords edible tubers, which are known as *Ato sang*, and **D. globosa** the *Bengo nari*. In many parts of Western India **D. pentaphylla** is known by the name *ulsi* or *ulasi* (*ufi*, *ubi*, *papa*, are American names). The name *kríss* seems to be the most general for the species of **Dioscorea** in the Panjáb, but that name is practically confined to the hill tribes; the tubers when offered for sale are known as *tarar*, a name that at once brings to mind the Malay *tallus*, *tales*, the Otahitan *tallo* or *tarro*, and the Bombay *terem*, names for **Colocasia antiquorum** (Conf. with *Dict. Vol. II.*, C. 1731). **Atkinson** affirms that in Kumáon **D. sagittata**, *Royle*, is known as *tair* and *turar*, words (which with the Panjáb *tarar*) may be admitted as recalling one of the generic names,—*tega*—which **Sir Walter Elliot** states is, with the Telegu-speaking people, a synonym for the Sanskrit *pindáluh* (see also *Wilson, Sanskrit Dict., p. 384*, and *Heyne, Tracts on India, p. 55*). The commonest

DIOSCOREA.

Telegu generic name for all the **Dioscoreas**, **Elliot** tells us, is *pendu lam*, which he points out is the equivalent to the Sanskrit *pindáluh*. Under the *Chára kanda* (**Colocasia nymphæfolia**) **Sir Walter** draws attention to the fact that **Brown**, in his Dictionary, is incorrect in assigning **Wilson's** account of the *pindálu* to a **Colocasia**; **Elliot** makes no mention of *álú* or any form of that word as applied to any aroid. Thus, it may safely be affirmed that throughout India there are names for the **Dioscoreas** that belong to the languages of the aboriginal races as well as those that are of a more classical Asiatic character, the latter most frequently approaching to the word *álú*, while a third set of names may have been derived from foreign and mostly American sources.

It seems probable that, as articles of food, the **Dioscoreas** of the world were cultivated at a much later date than most other vegetables, probably on account of the fact that without the trouble of cultivation they afforded an unfailing supply of food. This fact might be assumed as leaving them in the hands of the dwellers in forests instead of allowing of their advance, with civilisation, into cultivated areas. The ancient Egyptians were not aware of the value of these tubers, and, indeed, they are doubtfully cultivated (or only to a small extent) in the Egypt of to-day. The volume of existing evidence on the origin of the cultivated **Dioscoreas**, however, points to a possible independent discovery in Asia, America, and Africa. Interchanges from these regions might easily have taken place down to the present date, and the knowledge of the properties of these useful cultivated tubers may be assumed to have thus become widely and rapidly diffused. From the Indian source cultivated forms may have been carried to the West Indies, or brought from the West Indies to India during the period of Dutch and Portuguese influence. **DeCandolle** states that in Mauritius a yam bears the name of *Cambare marron*. "Now Cambare is something like the Hindu (*sic*) name *kam*, and *marron* indicates a plant escaped from cultivation." But this derivation ignores the fact that *Camotes* is a Mexican name for the sweet-potato, so that the syllable "Cam" in American words and *Kham* in Indian, need be viewed as nothing more than a coincidence similar to the appearance of the same letters in the name **Amorphophallus campanulatus**—the modern botanical name for one of the plants associated in the confusion regarding yams and potatoes. On the other hand, many writers contend for a more pronounced Asiatic origin for the yams, holding that they are indigenous to the Burma-Malay Peninsula, and that India mainly furnished the stock now cultivated in the West Indies. In part support of this opinion it may be added that the Indian wild species increase in number and abundance on passing into the Eastern Peninsula. They are, however, nearly as abundant on the Western coast, but become rare in the central table-land, and are scarcely represented in the northern dry areas. Thus one of the head-quarters of the Indian **Dioscoreas** is in the very region where the early European settlers first established themselves.

Considerable ambiguity, it must be admitted, has crept into the Anglo-Indian literature of Yams, and this has greatly increased the labour of establishing satisfactorily the names to be given to the species of **Dioscorea**. In popular works of travel, official reports, and other such publications, the word "Yam" is practically used to embrace all starch-yielding tubers other than potato and arrowroot. Thus aroids, yams proper, sweet-potatoes, &c., &c., are all designated yams—a confusion which receives practically no countenance from vernacular terminology. This fact has compelled the writer, in drawing up the present account of the species of **Dioscorea**, to reject all descriptions of yams in which he could not, from internal evidence, discriminate the plant or plants referred to. This has naturally deprived him of more than half the economic information that exists on the subject of yams, and has reduced very considerably the list of vernacular names that doubtless might be given for the species of **Dioscorea**. It may here

also be admitted that the present account is at most but a compilation of economic information. The writer has been unable to personally verify the facts given or to work out the scientific synonyms of the plants. The references to the authors consulted will, however, afford a key to any rearrangement that may be found necessary on the Indian species of **Dioscorea** being re-determined and described. Even in cases where no doubt existed that a yam proper is referred to, it has often been impossible to relegate to individual species the economic information available. This has necessitated to a large extent the production of the present article on yams collectively instead of the usual course followed in this work, of a separate account for each species, its vernacular names, structural and economic peculiarities, and modes of cultivation, &c., &c.

Special Opinions.—Since writing the above account of yams, and in reply to letters expressing the opinions he had formed on the subject, the writer has had the pleasure to receive two most instructive communications from **Dr. W. Dymock** of Bombay and from **Dr. Prain** of the Calcutta Botanic Gardens. Instead of incorporating the facts thus procured in the general statement, it has been deemed preferable to give these communications in this place. **Dr. Dymock** writes :—

"It is very difficult to say what the original *alu* of Sanskrit writers was; in Hindi it means yam, sometimes as *rat-alu* (red yam); in Marathi it is applied to **Colocasia, Calladium,** and similar plants. *Rukh-alu* or *tree alu* is **Remusatia vivipara,** which has leaves and flowers like **Colocasia,** but sends up curious spikes covered with minute bulbs. This word is purely Sanskrit and is current in Marathi. *Kachu,* the Hindi and Bengali name for these plants, is also Sanskrit. *Kachora* and *kachu* are also applied to the **Curcumas** in Hindi, Marathi, and Bengali. **Amorphophallus** is *Súrana,* and *ola* or *olla* in Sanskrit and in the vernaculars; it is also *Kand* in the vernaculars as *Jini-kand* (Edible tuber). *Súrana* is derived from (*súr*) to hurt; all the wild kinds are very irritating. In Marathi the name *Súran* seems to be applied to all Aroids having the peculiar shaped tuber of **Amorphophallus.**

As regards yams we find purely Sanskrit names in the vernaculars, such as *Pásh-poli* from *pásh* a noose and *poli* a cake, Anglic-strangle-cake, as the wild kinds irritate the throat and cause a sensation of strangling. This name is current in Marathi for wild yams, which are also called *Manda,* a Marathi name for a cake like a mincecake full of *Rawa* and sugar instead of mince-meat.

Cultivated yams are called *kon* and *konphal* in Marathi, *kand* in Hindi and Guzerathi, from the Sanskrit *Kanda.* This word spelt *Kanda* is applied to all tuberous roots and bulbs in Marathi just as it is Sanskrit. Another Marathi name for cultivated and uncultivated yams is *Cháin* or *Cháyen.* The Sanskrit names *alu* and *kanda* are about as vague as the Bolbos of the Greeks, but we know that *surana* means **Amorphophallus** from the epithet *Arso-ghna* or "destroyer of piles" applied to it, for it is still used as a remedy for piles.

Dr. D. Prain, Curator of the Calcutta Herbarium, has favoured the writer with the following note on the subject of the Asiatic distribution of the species of **Dioscorea** and of **Arisæma** :—

"I have gone through the whole of the works dealing with the 'Orient' of **Boissier** and the 'Central Asia' of the Russian writers, and I find that none of them mention either **Colocasia** or **Amorphophallus. Boissier's** Supplement brings our knowledge down to 1888, and **Trautvetter's** Incrementa to 1884, while **Maximowicz's** last paper (*Mel. Biol., XII.*) brings us also down to March 1888.

"**Arisæma** finds no place in the pages of Russian authors. In the *Flora Orientalis V., 43,* **Boissier** describes **A. abbreviatum,** but he states that he had not seen the plant, and gives only **Aitchison's** Kurram Valley Flora locality. In the App. to V. (p. 734) he adds **A. Jacquemontii,** also from

DIOSCOREA.

Aitchison's Kurram plants, remarking that he has seen the plant himself. He does not, however, give any other locality for either species, nor does he mention any economic uses.

"No **Dioscorea** appears in *Ledebour*, the standard Russo-Siberian Flora. Maximowicz gives D. 5-loba in *Prim. Flor. Amur. et Mands.* He gives no other in any of his 'diagnoses' (of which he publishes the 12th paper this year), nor does **Trautvetter** *l. c.* who brings the Russian Flora up to date at intervals.

"**Boissier** notes (under **Tamus**) on **Baker's** authority, that **Aitchison** had found **D. deltoidea** in Kurram, but for all that does not provide a description in his Flora. I find no mention under the families you refer to of any edible tuber, either in **Boissier** or in the Russian authors."

CULTIVATION OF YAMS IN INDIA.

The yam may be propagated by means either of the ærial tubers which form on the stem or by means of small under-ground tubers or portions of large ones. The ærial tubers are not, however, often used, as the plants in that case require two years to reach maturity. The usual process is to dig the ground to a considerable depth and to manure it fairly well; then form pits near trees, so as to afford support for the climbing stems, and deposit in each pit a small tuber or portion of a large one. Lateral shoots should be nipped off, otherwise large tubers will not form. If it be desired to plant an area of ground entirely with yams, the ground should be trenched and the tubers deposited two feet apart along the furrows. To afford support for the plant a trellis work should be constructed between the ridges. The Chinese have a method of producing a large crop of small tubers without having to incur the expense of providing a support for the plants. The tubers are planted 3 or 4 feet apart along the crest of ridges and the stems made to take root at various points by being pinned down on the ridges. By this means a crop of tubers very much like potatoes is produced, the tubers forming at each point where the stem is pinned down into the earth. It is often the case in India that the long stems are not provided with a support nor are they pinned down. They are simply allowed to spread over the ground. This is a slovenly practice and results in much smaller tubers than when the stems are provided with a means of climbing. **Firminger** states that yams should, in the plains of India, be planted in April and the crop taken up in December. The varying periods peculiar to the better known species will be found indicated in the pages that follow, but the imperfect knowledge which exists on the subject of Indian yams precludes more being done than to bring together the scattered notices.

Mr. R. Mitchell, Emigration Agent for British Guiana, Calcutta, has for some years past been prosecuting most successfully the effort to introduce improved forms of yam into India. He writes: "The Jamaica yams appear to have become thoroughly acclimatised, and yielded in 1885 at the rate of about eight tons to the acre, and last year, when they were planted rather too late, gave about five. As far as I have been able to determine, the Jamaica yams with which these experiments have been made are of three distinct kinds—the smooth white, the rough white, and the rough variety slightly tinged with pink. The last mentioned is coarser than the other two, but good for food. It also bears seeds on the vine which make excellent plants.

"The other yams I imported from British Guiana comprise four varieties—The Kush-Kush or Buck-yam, the most delicate of all the species, the White Hunt, originally from Barbadoes, also a great favourite, the Stack, and the Lisbon yam.

The only plant of Buck-yam which reached me alive was about the size of an almond. I planted it carefully, but more than once its growth was checked by accidents. When the vine withered, I dug it up and found the produce about the size of a lady's thimble—by no means an

DIOSCOREA.

encouraging result. It was planted again and tended still more carefully, and last year produced a yam large enough to give seven plants, fully as big as I have ever seen it in the West Indies, for it gives the smallest return of any, but is by far the most delicate. Two of the seven plants are dead, but the remaining five appear to be thriving well. The other yams yielded little more than plants, and were too small almost to eat, so they have been planted again.

I am unable to say why they have not yielded a better return, possibly they may not have been long enough acclimatised, or were planted too late last year. They appear, however, to be thriving now, judging by the growth of the vines, which are luxuriant.

The extent of land on which these experiments have been carried out is small, about $\frac{1}{18}$th of an acre, the soil light, and of reasonably good quality.

I have taken so much pains to acclimatise the West Indian yam, because the varieties I have tasted here are almost uneatable, very stringy and hard, with an unpleasant earthy flavour, such as may be met with in some of the coarser West Indian varieties. I may add that the yams I am experimenting with are all water yams, and most of them very delicate and delicious food. In fact, the Buck-yam is superior, in the opinion of many, to the best potatoes.

"I am also conducting experiments in the Hill near Hope Town at different elevations with these yams, with the kind co-operation of Messrs. Johnstone and Calvert, who have planted several at lower elevations. The first I planted in March at 5,200 feet above sea level rotted almost without exception before the roots and germinal shoots from the bark had time to appear. I, therefore, waited until May and planted out fifty more which had already sprouted, and most of them grew up and looked healthy.

"The result of this hill experiment will also be communicated to you. I fear, however, that at elevations above 3,000 feet, the yam can scarcely prove a valuable addition to the root crops of the hills, being too much of an exotic. In the plains, however, where the rainfall is not less than fifty inches and fairly distributed, and the soil arenaceous and moderately good, the West Indian yam should prove a valuable addition to the food of the people. It requires from seven to eight months to attain to its full growth, and should be provided with sticks to run on, although a small patch, which was not supplied with poles, produced about as much as the rest of the ground where a bamboo trellis was provided to support the vines.

"My father and I have experimented on yams for many years. I obtained from Barbadoes some of the finest varieties of the water yam, which in that island seldom exceed eight or ten pounds in weight. In Trinidad, however, the plants throve amazingly, and the weight was increased. In one instance a yam which I had dug and weighed myself turned the scale at 82lb. and many others averaged from 30 to 50lb.; moreover, these enormous yams did not in any way deteriorate in flavour, and proved quite as delicate as the original stock.

"Should you arrive in Calcutta before the vines wither, about Xmas time, I should have much pleasure in showing you the patch of yams at present under experiment.

"The cultivation is simple, but laborious. The ground is dug into trenches about two feet wide by eighteen inches deep, three feet apart from centre to centre. The trenches are filled with leaves, weeds, and garden rubbish of all kinds, which admit of the free expansion of the tubers. The mould from one trench forms the bed over the preceding one. The soil being uniformly good it does not matter much where the sub-soil is placed; if poor I should put it beneath in direct contact with the accumulated vegetable matter and out of the way of the young rootlets, seeking the nourishment which they would be more likely to find among the humus of the surface soil.

The yams, cut to about the size of an ordinary man's fist, care being

DIOSCOREA.

taken to preserve as much of the outer surface as possible, are planted at intervals of three feet in the beds. The lops in the absence of seeds are the legitimate plants, and rarely fail to grow.

Seeds where procurable made excellent plants. There are seasons, however, when few, if any, appear, why I am unable to say, although this has also been a subject of experiment. As far as I have observed, however, the coarser varieties bear seeds most abundantly and frequently.

"I prefer sprouting the pieces of yam cut for plants under a layer of grass and mould a few inches thick, which should be watered at intervals. The seed bed should be prepared in the end of March, or early in April, when the seasons are similar to the weather in Calcutta. In from 3 to 6 weeks the yams commence to sprout and should be planted out at once, as the young shoot, which grows with great vigour and rapidity, even in the corner of a dark room on a stone floor, soon weakens the parent."

Dioscorea aculeata, *Linn.; Roxb., Fl. Ind., Ed. C.B.C., 728; Wight, Ic., 2060;* DIOSCOREACEÆ.

PRICKLY-STEMMED YAM or GOA POTATOE; KAAWI YAM; the GUINEA YAM.

Vern—*Man-álu*, HIND.; *Mou álu* (or *mauálu*), BENG.; *Kánta*, or *Kántékángi* (Bazar name *botat*), BOMB., GOA; *Chhota-pindálu*, DEC.; *Kantú-kelangú, sirru-vullie-kelangu*, TAM.; *Kata-kelenga, kummara baddu, dampa*, TEL.; *Genasu*, KAN.; *Pudie-kelengu*, MALAY; ? *Kahu-kukulalu* (according to **Balfour**), SING.; *Madhválu*, SANS. This appears to be the *Bir sangi* of the SANTALS.

References.—*Voigt, Hort. Sub. Cal., 652; Duls. & Gibs., Bomb. Fl. Supp., 92; Drury's Hand-book, Indian Flora, vol. III., 276;* is probably the *Katta kelangu* of *Rheede, Hort. Mal., VII., 37;* the *Cumbilium* of *Rumph. Amb., V., t. 126; U. C. Dutt, Mat. Med. Hind., 308; Dymock, Mat. Med. W. Ind., 2nd Ed., 842; Mueller, Select Extra-Trop. Pl., 106; Mysore Gaz., II., 11; Lisboa, U. Pl. Bomb., 178; Birdwood, Bomb. Pr., 178; Balfour, Cyclop., 950; Jour. As. Soc., Pt. II., 2, 1867, 82.*

Habitat.—A native of Bengal and of Western and Southern India: cultivated more or less in most provinces.

Description.—The tubers are described as oval or oblong, composed of a delicate white and rich starch. They are generally about two pounds in weight, but often considerably smaller. The stems are not winged or angled, but possess numerous prickles, and are sufficiently stout to allow of the plant being cultivated without the aid of stakes. Leaves alternate or sub-opposite, base deeply cordate; nerves 7 to 9. Flowers minute on panicles; base of the fruit tapering.

Dalzell and **Gibson** appear to have been the first authors to observe this plant under cultivation. To **Roxburgh** it was only known as a wild product. The Father of Indian Botany says that the tubers in his time were "dug up in the woods, for it is not cultivated, and carried for sale to the market at Calcutta." He adds that this occurs "during the cold season." **Dalzell** and **Gibson** say: "It is the smallest of the cultivated species, but it is also the most delicate." They add that it is common in Bombay, but was originally "imported from Goa." In his *Useful Plants of Bombay*, **Lisboa** writes of this plant that it grows "in very good soil to a very large size; white and mealy, and is much appreciated." **Dymock** says that it is less common in Bombay than **D. sativa** and **D. globosa**, "but deserves to be more generally known, as it is the whitest and most delicate of the species and is dry and mealy and quite free from the mucilaginous taste which makes the common yam cloying to the appetite; it is planted in June, just before the rains, and in November yields a cluster of tubers similar in shape and size to kidney potatoes." **Firminger** (*Manual of Gardening for India*) is silent as to this species, a fact to be perhaps accounted for by his knowledge being chiefly local (namely, Bengal), and

this, together with **Roxburgh's** statement that it is not cultivated, may be accepted as establishing this as a more peculiarly Bombay and Madras cultivated plant. **DeCandolle** lays stress on the fact that none of the Indian cultivated yams have been found in a wild state. But this statement should have been that none of the Bengal cultivated species had been observed by **Roxburgh** as existing in a wild state. **Roxburgh** was practically ignorant of the Flora of Western India, and, had a contemporary of anything like **Roxburgh** in ability, described the plants of Bombay, it is probable that on many debatable points of plant distribution, we should have held very different views than those current on such subjects. There is nothing in **Roxburgh's** statements to disprove the opinion that **Dioscorea aculeata** was not a wild as well as a cultivated plant at the very time at which he wrote. **Mueller** (*Extra-Tropical Plants*) seems to hold that it is a native of "India, Cochin-China, and the South Sea Islands."

This may be so, but the writer can discover no mention of its occurring either in Eastern Bengal, Assam, or Burma, where (if a native of Cochin-China) it might have been looked for. According to many writers it is one of the best of yams, being often very sweet, almost like a sweet-potato. **Dr. Seeman** regarded it as one of the best of esculent tubers.

Roxburgh's account of the tuber having in his time been collected in the "woods," and taken to the "Calcutta market" is interesting. The writer is aware that the rural population and aboriginal hill tribes regularly gather this wild tuber, but he does not recollect of ever having seen it offered for sale in Calcutta. Indeed, Bengal is not a large consuming province for yams, the potato having gained too strong a position for that. Such yams as are to be found in the bazars appear all to be regularly cultivated. It seems probable that a far larger number of yams are consumed in Bombay than in Bengal. The principal species grown in Bengal is **D. globosa**, and after that the next most important is **D. alata.** In Bombay **D. sativa** (the long yam) and **D. globosa** (the round yam) are about equally abundant, and next to these comes **D. aculeata**; **D. alata** is apparently but rarely met with in Western India.

Food.—Tubers extensively eaten. In the *Mysore Gazetteer* it is stated that *Genasu* is "one of the chief cultivated products in these districts."

Dioscorea alata, *Linn.; Roxb., Fl. Ind., Ed. C.B.C., 727; Wight, Ic., 810.*

YAM, or WING-STALKED YAM. This is the WHITE YAM of Ainslie and the UVI or UBI of Australia, Java, &c. Sometimes called BARBADOES YAM.

Vern.—*Khám-álu*, HIND. and BENG.; *Goradu*, KHANDESH; *Chin*, KOLHAPUR; *Kam álu*, BOMB.; *Kon*, POONA; *Rat álu*, GUZ.; *Kalung, Yams-kalung* (according to **Ainslie**), TAM.; *Gudimi donda pendalam, niluvu-pendalum*, TEL.; *Pendalam*, NELLORE; *Perinvullie kélunghu* (**Ainslie**), MALAY; *Kirri-kondol, kahata-kondol, lingúrella*, SING.; *Dandálu*, SANS.

References.—*Voigt, Hort. Sub. Cal., 652; Thwaites, En. Ceylon Pl., 326; DC., Origin Cult. Pl., 77; Drury, Hand-book of Indian Flora, III., 274;* Katsji-kelengu *of Rheede, Hort. Mal., VII., t. 38; Mueller, Extra-Trop. Pl., 106; Ainslie, Mat. Ind., I., 329; U. C. Dutt. Mat. Med. Hind., 296; Year Book, Pharm., 1878, 275; Bomb. Gaz. (Poona), XVIII., 56; Bom. Gaz. (Khandesh), XII., 171; Nellore Manual, 405; Banda (N. W. P.) Gaz., 85; Indian Forester (III.), 236; Firminger, Man. Gard. Ind., 121; Lisboa, U. Pl Bomb., 178; Birdwood, Bomb. Pr., 178; Balfour, Cyclop., 951; Sir W. Elliot, Fl. Andh., 56, 134.*

Habitat.—This species is much cultivated in various parts of India, and is one of those that **Roxburgh** had not seen in a wild state, and to which **DeCandolle** makes special reference. **Lisboa** (*Useful Plants of Bombay*), however, remarks that it is "wild in the Konkan," and **Drury** that it occurs in both Konkans "flowering in the rainy season." **Ainslie**

IOSCOREA.

writes of the white yam that "The plant is the Dioscorea alata, *Linn.*, and is indigenous in the Indian islands, where, however, though the yam often grows to a large size, it is not so delicate a root as in India. In the western parts of the Archipelago it is called *ubi*; in Ternate *ima*; in Macassar *lami*; in Amboyna *heli*; and in Banda *lutu*." Roxburgh says this is the only species cultivated for food on the Coromandel Coast; flowering time the close of the rains. Wight remarks that this species is "universally cultivated in the Carnatic, being that which produces the yam." Thwaites mentions it as cultivated in Ceylon.

Description.—The tubers are oblong, white internally, brown on the surface. They often attain a great size, being sometimes 8 feet long, and weigh 80 to 100lb. The stems are four-angled, with wide-spreading wings along the margins; they are rarely prickly, only a few prickles occurring on the lower portion of the stem.

There are numerous recognisable cultivated forms of this plant, some approximating to D. purpurea. According to Roxburgh this species is extensively cultivated in India, and holds the second place in popular estimation, following D. globosa and preceding D. purpurea.

Food.—The tubers are extensively eaten. "The common yam is grown in small quantities without water or manure in the hilly waste round the edges of fields or in house yards. If left to grow till December the root attains 2 feet long and 8 inches across. The plant, which is a creeper with longish pointed leaves, bears two to five tubers or roots which, when boiled, make an excellent vegetable" (*Bomb. Gaz., XVIII., 56*). "There are two or three cultivated kinds, and several wholesome wild yams are gathered both for food and medicine" (*Bomb. Gaz., XII., 171*). Of Nellore it is reported that there are two forms of yams grown—a white and a red. "The land is well ploughed, then holes are dug and manured, and cuttings of the yam are put into each, and watered till they sprout about the eighth day. The plant spreads over the ground if there is no frame at hand for it to climb. If trained to a frame the roots are much larger than when the plant trails along the ground" (*page 405*).

Dioscorea anguina, *Roxb.; Fl. Ind., Ed. C.B.C., 728.*

Vern.—*Kúkúr-álu*, BENG.

Habitat.—Roxburgh speaks of this species as a native of the neighbourhood of Calcutta; flowering at the close of the rains.

Food.—Tuber not esteemed, though eaten by the poor when hard-pressed.

D. atropurpurea, *Roxb.; Fl. Ind., Ed. C.B.C., 728.*

THE DARK PURPLE YAM: MALACCA YAM; sometimes sold in Calcutta under the name of RANGOON YAM.

Vern.—*Myouk ni*, BURMESE.

References.—*Kurz, Pegu Report, XXII.; Mason's Burma, 465; Balfour's Cyclopædia, 951; Firminger, Man. Gar., 122.*

Habitat.—Kurz enumerates this species as one of those collected by him in Pegu. Roxburgh remarks: "This is the species so extensively cultivated in Malacca, Pegu, and the Eastern Islands." It is grown both by the Karens and the Burmese, and Mason says of it that it is "one of our best yams."

Description.—Roxburgh referring to the tuber of this plant says it grows so large that it may be seen through the cracks in the dry ground caused by the growth of the tuber. The tubers are irregular, round, smooth, and like the stems of a deep purple colour. The stems are mostly four-winged, often five or even seven-winged. The leaf-stalks are also winged and stem clasping.

DIOSCOREA.

Dioscorea Batatas, *Decaisne.*

Vern.—*Sain-in*, CHINESE.

References.—*DeCandolle, Origin Cult. Pl., 78; Agri.-Hort. Soc. Ind., IV., New Series (1874), p. 40.*

Habitat.—Extensively cultivated in China, but not hitherto found wild in that country. Was early introduced into Europe, where it may occasionally be found under cultivation, though it has not attained a high reputation as a vegetable, but it is the most temperate of the cultivated species hitherto brought to notice, and is thus the one which might succeed best in the higher alpine regions of India.

According to some writers this is only a cultivated state of **D. glabra**, *Roxb.*, and on this account mainly is it mentioned in this work, as apparently the cultivated plant described by **Decaisne** is not grown in India.

D. bulbifera, *Linn.; Wight, Ic., t. 878.*

BULB-BEARING YAM.

Syn.—HELMIA BULBIFERA, *Kunth.*; DIOSCOREA TAMNIFOLIA, *Salisb.*; D. PULCHELLA, *Hokenhacker*; D. PULCHELLA, *Roxb.*

Vern.—*Zamín kand*, HIND.; *Piska*, SANTALI; *Zamín khand* (the tubers), PB.; *Karinda* (or *hadu-karanda*), BOMB.; *Karanda*, POONA; *Karu-karinda*, DEC.; *Kurú kanda*, CHANDA; *Kathálu, patni-alu, mati álu*, ASSAM; *Maláká-kaya-pendalam, chedu paddu dumpa* (according to **Elliot**, for **D. pulchella**, *Roxb.*), TEL.; *Katu-katsjil*, MALAY; *Panú-kondol*, SING.

References.—*Thwaites, En. Ceylon Pl., 326; Dals. & Gibs., Bomb. Fl., 247; Stewart, Pb. Pl., 229; Drury, Hand-book, Indian Flora, III., 277; Rheede, Hort. Mal., VII., t. 36; Kunth, Enum., V., 435; Trimen's Cat. Ceylon Pl., 93; Year-Book, Pharm., 1878, 275; Bomb. Gas. (Poona Dist.), XVIII., 56; Baden Powell, Pb. Pr., 259; Drury, U. Pl., 182; Lisboa, U. Pl. Bomb., 179; Birdwood, Bomb. Pr., 178.*

Habitat.—Wild in Sylhet, Chittagong, and throughout the Western Ghâts to Bombay. Cultivated in the Western Presidency, especially in the Konkan. It is also mentioned by **Aitchison** as occurring at Moradabad and Simla, and is enumerated by **Strachey** and **Winterbottom** as met with at Almora, flowering in July. **Baden Powell** refers to samples of this tuber having been sent to the Lahore Exhibition from Simla, Kashmír, and Hushyarpur. (Conf. with the tuber described under **D. deltoidea**, which is specially mentioned by **Aitchison** as collected at Hushyarpur.) **Baden Powell** accepts the tubers sold under the name of *Zamín khand* as being those of this species. Of the *karanda* yam of Poona it is said that it differs from the *kon* (**D. alata**) in having rounder leaves and in bearing bulbs on the stems as well as on the roots. **Elliot** says that **D. bulbifera** was introduced into India from the Straits.

Medicine.—The tubers are applied to ulcers after being dried and powdered. In the plains of the Panjáb the leaves of a species of **Dioscorea** (most probably this) are used medicinally and sold under the name of *tarar puttr*. **Baillon** (*Dictionnaire de Botanique, Vol. II., p. 437*) alludes to the known febrifugal property of the leaves of certain species of **Dioscorea**, rendering them useful in the treatment of intermittent fevers.

Food.—The bulbules on the stems and the tubers under ground are used as vegetables (*Birdwood*). The latter are bitter, but are rendered eatable by being covered with ashes and steeped in cold water. In a report on Assam it is stated that the tubers are boiled in *khar* water, or in an acid before being eaten.

Dr. Stewart, under the name of **D. deltoides**, *Wall*, "(and **D. bulbifera**, *L.*?)" gives the following vernacular names: *kníss, kríss, tar, kithí, tardí, gúngrú, kaspat*, &c., and states that the plant he refers to grows abundantly in many parts of the Panjáb Himálaya; that the root (several pounds in weight)

DIOSCOREA.

is largely eaten, cooked, by various classes in parts of the Siwaliks and outer hills, *after steeping it in ashes and water to remove acridity.* It is difficult to know to which of the Panjáb species **Stewart** more particularly refers. He says that in Kashmír the roots are employed for washing pashm and wool cloth. **Vigne** (Stewart further informs us) affirms that a smaller kind is used to wash cotton cloth, and a third reputed to be used for silk. **Honigberger** states that a yam is also employed in dyeing *nafarmání* (blue). **Baden Powell** describes the *Zamín khand* tubers as follows:—"When the root is cut open it is yellowish inside; at first it is very bitter and requires to be boiled several times, and sometimes also with lime water, before it is fit to be eaten. It is used also as pickle. For this purpose it is cut into little pieces and fried in oil till it becomes of a red colour, and then it is put into vinegar, &c., or in the mixture of mustard seeds ground up with salt, &c., in water or oil, which is sometimes used as a preservator."

Domestic Uses.—"The tubers of this species are employed by the Singhalese for attracting fish to certain spots where they can be easily caught. The tubers are broken into pieces and thrown into the water daily for some time" (*Thwaites*).

Dioscorea crispata, *Roxb.; Fl. Ind., Ed. C.B.C., 728.*

Vern.—*Rudraksha pendalam, káya pendalam,* TEL.; *Myouk-kya, ká-bu nway, ta-tway-u,* BURM.

References.—*Kurz, Report on Pegu, XXII.; Drury, Hand-book, Flora of India, III., 276; Voigt., Hort. Sub. Cal., 652; Elliot, Fl. Andh., 90, 165.*

Habitat.—"A native of the interior of Bengal" (*Roxb.*), and according to **Kurz**, of Pegu in Burma; flowering time, the rainy season.

D. dæmona, *Roxb.; Fl. Ind., Ed. C.B.C., 729; Wight, Ic., t. 811.*

Syn.—HELMIA DÆMONA, *Kunth, Enum., V., 439;* UBIUM SILVESTRE, *Rumph., V., t. 126.*

Vern.—*Pedumpa, puli dumpa,* TEL.; *Kyway, kyway-nway, kyway-pin,* BURM.

References.—*Kurz, Pegu Report; Voigt, Hort. Sub. Cal., 653; Dals. & Gibs., Bomb. Fl., 247; Atkinson's Him. Dist., 602; Hooker, Niger Flora, 538; Elliot, Fl. Andh., 147, 158.*

Habitat.—**Roxburgh** mentions this as a native of the Gorakhpore forests as well as of the Moluccas. **Kurz** describes it as occurring in Pegu.

It is also enumerated in the list of plants collected by **Strachey** and **Winterbottom** in Kumáon, where it is stated to occur at altitudes of 2,500 feet. **Dalzell** and **Gibson** write that it is met with 'at Vingorla: Hills in Concan, rare." It is also found in Africa, a specimen being described (in *Hooker's Niger Flora*) as "apparently the same as the widely-diffused East Indian plant."

Food.—The tuber is very nauseous, even after being carefully boiled.

D. deltoidea, *Wall.*

Vern.—*Gún,* KUMAON; *Kniss, kriss, tar, kithi, kheli, dharúr, tardi, tharri, káns, gungrú, kaspat, parwatti*; and the bazar name for the medicinal leaves *tarar pattr,* PB. **Baden Powell** gives this species the Panjábi names *tarar, krish.*

References.—*Stewart, Pb. Pl., 229; Baden Powell, Pb. Prod., 259, 378.*

Habitat.—A common Himálayan species, occurring between 3,000 and 8,000 feet: flowering time, May. It often attains a considerable size, spreading over trees and bushes for 15 to 20 feet. Frequent in the vicinity of Simla and throughout Kulu, being distributed into Afghánistan. The deltoidly often trilobed leaves of this plant are very characteristic, but the small flowers occur on a lax, elongated axis in a manner peculiar to this plant.

The above Panjáb vernacular names are taken from **Stewart's** *Panjáb Plants*, but it seems probable they are the names not for one species of **Dioscorea** but for all those met with in the Panjáb Himálaya. These names are, from a historic point of view, of great interest, and are reproduced here (and also under **D. bulbifera**) in the hope that future writers may be able to properly distribute them to the species to which they more especially belong. **Aitchison**, in his *Catalogue of Panjáb and Sind Plants*, mentions three species—**D. sagittata, D. bulbifera**, and **D. sp.**, undetermined. Regarding the last he says that it is found near Hushyarpur and "yields a large tuber, much sought for at certain Hindu feasts. The ground where this grows is one mass of pits from the continuous digging for the tubers called *Thurí*." It has been repeatedly urged that much damage is done to young seedling trees by the deep pits dug throughout the forests while searching for yams.

Dye.—**Stewart**, in his Notes on a Tour in Khághán, mentions the *kríss* tubers as used for washing silk.

Medicine.—The leaves of this species are sometimes spoken of as used medicinally, having febrifugal properties assigned to them. The tubers are employed as a detergent and also in dyeing (Conf. with **D. bulbifera**).

Dioscorea fasciculata, *Roxb.; Fl. Ind., Ed. C.B.C., 728.*

THE KIDNEY-SHAPED YAM; KAREN POTATO.

Vern.—*Súsní álu, sathui*, BENG.; *Suthni*, BIHAR; *Kangar*, POONA; *Kadwœ-oo, tá-tway-u*, BURM.

References.—*Voigt, Hort. Sub. Cal., 652; Mason's Burm., p. 464, 813; Kurs, Prelim. Report, Pegu, XXII; Grierson, Bihár Peasant Life, 250; Firminger, Man. Gard., 122; Bomb. Gas., XVIII, 56.*

Habitat.—"Cultivated to a considerable extent in the vicinity of Calcutta, not only for food but to make starch of the roots." (*Roxb.*) It is cultivated extensively by the Karens, and, being more like the potato than the yam, has acquired the name of the Karen potato or Tavoy potato. **Mason** adds: "I am not aware that it is ever found wild on the coast.' **Kurz** mentions this species, however, in his *List of Pegu Plants*, but does not state whether gathered from a wild or cultivated stock. According to a writer in the *Bombay Gazetteer*, *kangar* is grown in Poona.

Description.—The root consists of several small, smooth, light-coloured tubers, which are used by the natives for food and for the manufacture of starch. (*Roxb.*)

Mason describes this species thus: "This is a small yam, not much larger than a kidney potato, which it much resembles both in appearance and taste." "It is the best vegetable we have, but unfortunately it can be obtained during a few months only in the year." The Poona yam referred to above is described as "closely resembling the *kon* (**D. alata**) and the *karanda* (**D. bulbifera**). It is found in the hills. Its bulbs, which form below the ground, are like a small sweet-potato in size and shape. The flesh is white and sweet" (*Poona Gas., XVIII., 56*). **Firminger** remarks that the *súsní álú* is "a very distinct kind of yam; the tubers are about the size, form, and colour of large kidney potatoes, and when well cooked bear a greater resemblance, in mealiness and flavour, to the potato than any other yam I know."

D. glabra, *Roxb.; Fl. Ind., Ed. C.B.C., 729.*

THE CHINESE YAM.

Vern.—*Eddu tóka dumpa, nára tega*, TEL.; *Ato sang*, SANTALI; *Káteh, myouk-mway*, BURM.

Sir Walter Elliot says the Telegu name means "Bullock's-tail root" owing to the length of the tubers. He further adds that *téga* is the tuberous root, *tíge* the twining stem.

DIOSCOREA.

References.—*Kurz, Pegu Report; Sir Walter Elliot, Flora Andh., 49, 129; Voigt, Hort. Sub. Cal., 653; Drury, Hand-book Fl. Ind., III., 274.*

Habitat.—A native of Lower Bengal and Sylhet.

Food.—The Rev. A. Campbell says this species is largely cultivated by the Santals of Chutia Nágpur, and that the ærial bulbs as well as the under-ground tubers are eaten. Mueller calls this the Chinese yam, and says the tuber is known to attain a length of 4 feet, with a circumference of 14 inches, and weight of about 14lb. "The inner portion of the tuber is of snowy whiteness, of a flaky consistence, and of a delicious flavour; preferred by many to potatoes, and obtained in climates too hot for potato crops. The bulbilles from the axils of the leaf-stalks, as in other Dioscoreas, serve as sets for planting, but the tubers from them attain to full size only in the second year, the produce being in proportion to the set planted."

[*t. 812.*

Dioscorea globosa, *Roxb.; Fl. Ind., Ed. C.B.C., 727; Wight, Icon.,*

THE COMMON YAM.

Vern.—*Chúpri álu,* HIND. and BENG.; *Bengo nári,* SANTALI; *Chaina, chopri álu, khaun phal, safed kanphal, myouk-phal,* BOMB.; *Gúna pendálam,* TEL.; *Pindálu,* SANS.

References.—*Voigt, Hort. Sub. Cal., 652; Dals. & Gibs., Bomb. Fl., Supp., 92; Mueller, Extra-Trop. Pl., 106; Firminger, Man. Gard., 121; Atkinson, Econ. Prod. N. W. P., V., 21; Drury, U. Pl., 183; Lisboa, U. Pl. Bomb., 178; Elliot, Fl. Andh., 65.*

Habitat.—This species is largely cultivated, especially in parts of Bengal. The tubers are roundish, sometimes very large, inside pure white. No writer appears to have noticed the plant in a wild state in India, though it is common under cultivation; the *Bengo-nári* of the Santals may not be this plant, but if it so it is wild at the foot of Parisnath. It flowers during the middle of the rains, the spikes of flowers being verticelled on a long axis.

Food.—The tubers of this species are the most esteemed of all the yams; they are eaten by the natives, and are also much liked by Europeans in India. Firminger does not agree, however, with Roxburgh in this high opinion regarding the tuber sold under the name of "*choopree álú*" being the best form of Yam. "Others appear to me," he adds, "to be superior." The natives eat them in curries, and also after being boiled. They are often baked into bread. Atkinson says the fruits of this species are edible. "Formerly largely used by the natives as a vegetable, but now almost entirely displaced by potatoes" (*Gas. Beng., I., 139*). They are said to be planted in June and dug up in January and February.

D. nummularia, *Lamarck; Roxb., Fl. Ind., Ed. C.B.C., 729.*

THE TIVOLI YAM.

Vern.—*Bhora álu,* HIND. and BENG.; *Káru pendalam,* TEL.

Habitat.—A native of the neighbourhood of Calcutta; flowering time the close of the rains. Root tuberous, small.

Food.—The tuber appears to be unfit for human food, according to Roxburgh; but Mueller calls this the Tivoli Yam and describes it as "A high climbing prickly species, with opposite leaves. Roots cylindrical, as thick as an arm; their taste exceedingly good." These writers in all probability allude to different plants.

[*Icon., 813.*

D. oppositifolia, *Linn.; Roxb., Fl. Ind., Ed. C.B.C., 729; Wight,*

Vern.—*Már-páspoli,* or *márapasapoli,* BOMB.; *Piska,* SANTALI; *Are tige* or *tégálu, avatenga tige,* TEL.; *Hiri-tala,* SING.

References.—*Voigt, Hort. Sub. Cal., 653; Dals. & Gibs., Bomb. Fl., 247; Lisboa, Useful Pl. Bomb., 179; Thwaites, Enum. Ceylon Pl., 326; Sir Walter Elliot, Flora Andh., 16, 18; Rev. A. Campbell's Econ. Prod. Chutia Nágpur; Mueller, Extra-Trop. Pl., 107; Drury, Hand-book of Indian Fl., III., 2/5; Trimen, Cat. Ceylon Pl., 93.*

Habitat.—A native of the east and west coasts of Southern India, extending north to Khandalla; of frequent occurrence in the sub-alpine forests. Flowering time the rainy season. Stems smooth, round, slender, twining, annual; leaves opposite, petioled, ovate-lanceolate, slightly cordate; inflorescence panicelled. Distributed to Ceylon and China.

Food.—Mr. Campbell says:—"The roots and the ærial tubers are eaten, the former being considered by the forest tribes as a great delicacy." This remark probably refers to **D. bulbifera**; one of Mr. Campbell's specimens of *piska* is certainly **D. bulbifera.** Dymock enumerates this plant among those used during famine time in Bombay, both the tubers and the flowers being eaten.

Medicine.—"The root, ground and heated, is applied to reduce swellings: it is also used in snake-bite and scorpion sting."

Dioscorea pentaphylla, *Willd.; Roxb., Fl. Ind., Ed. C.B.C., 730;* [*Wight, Ic., 814.*

THE KAWAN YAM OF FIJI.

Vern.—*Kanta-álu,* HIND.; *Kanta álu,* N.-W. P.; *Taguna, takuli, magina muniya,* KUMAON; *Kanta-alu, ulsi, shendorwel,* BOMB.; *Chataveli, úlasi,* MAR.; *Mullu pendalam, pandi mukku dumpa,* TEL.; *Nureni-kelangu,* MALAY.; *Pwá-sá-o, pho-sáo,* BURM.; *Katu-wala,* SING.

References.—*Voigt, Hort. Sub. Cal., 653; Thwaites, En. Ceylon Pl., 325; Dals. & Gibs., Bomb. Fl., 247; Rheede, Hort. Mal., VII., 34, 35; Sir Walter Elliot, Flora Andh., 118, 144; Dymock, Mat. Med. W. Ind., 2nd Ed., p. 843; Atkinson, Him. Dist., 389 & 602; Drury, U. Pl., 183; Lisboa, U. Pl. Bomb., 179; Birdwood, Bomb. Pr., 179.*

Habitat.—Common in the jungles, on low hills throughout the greater portion of India.

Wight remarks: "A sufficiently common species in jungles on low hills, &c., but never, so far as I have seen, cultivated, which is the more remarkable as I have always found the natives dig the tubers, whenever they had an opportunity to dress and eat them." **Roxburgh** says he has only seen this plant in its wild state. It occurs on the lower Himálaya ascending to 6,000 feet in altitude; common below Simla."

Description.—The stems are prickly and furrowed, rather hairy; leaves digitately 5-divided, downy, segments oblong acuminate. The tubers oblong, large, and white, considered wholesome and palatable.

Food.—Affords large edible tubers, eaten all over India. The flowers are also eaten as a vegetable; they are sold in the bazars of Bombay during the rainy season and are considered wholesome. The leaves are also sometimes eaten during times of scarcity and famine.

D. pulchella, *Roxb.; Fl. Ind., Ed. C.B.C., 728;* see **D. bulbifera.**

D. purpurea, *Roxb.; Fl. Ind., Ed. C.B.C., 727.*

THE PURPLE YAM.

Vern.—*Rukto-gurániya álu, Lal-gurania-álu,* HIND. & BENG.; *Désaválipendalam* (= Country or Common Yam), TEL.

References.—*Voigt, Hort. Sub. Cal., 652; DC., Origin Cult. Pl., 77; Elliot, Flora Andh., 46; Mueller Extra-Trop. Pl., 107; Firminger, Man. Gard., 121; Ainslie, Mat. Ind., I., 330; Atkinson, Econ. Prod., V., 22.*

Habitat.—Cultivated in most districts of Bengal. Ainslie says that many writers consider this only a purple form of the white yam (**Dioscorea**

DIOSCOREA.

alata). Firminger writes that this appears to be the tuber brought by a Mr. McMurray from Mauritius, and which is there cultivated as extensively as the potato is in England. "The tuber is of a dull crimson red outside, and of a glistening white within."

Food.—The tubers are oblong, throughout of a lighter or darker purple, but always considerably deep in the tinge. (*Roxb.*)

It is reckoned by the natives as the third best among the yams, **D. globosa** being considered the first and **D. alata** the second.

Dioscorea quinata, *Wall.*

Vern.—*Magiya, muniya,* KUMAON.

Habitat.—Said to be met with in the North-West Himálaya at altitudes of 6,000 feet.

Food.—Yields white edible tubers.

D. rubella, *Roxb.; Fl. Ind., Ed. C.B.C., 727.*

Vern.—*Guraniya álu, goran álu,* BENG.

References.—*Voigt, Hort. Sub. Cal., 652; Firminger, Man. Gard., 122; Gas. Bengal, V., 307; Atkinson, Econ. Prod. N.-W. P., V. 22.*

Habitat.—Much cultivated in parts of Lower Bengal, especially about Calcutta. Stems twining 6-winged; leaves opposite sagittate cordate, 5-7-nerved with subulate points. Tubers oblong, sometimes 3 feet long, deeply tinged with red under the epidermis.

Food.—Held fourth in estimation by Bengalis, and used by them as food. "Fleshy and farinaceous, and may be used as an excellent substitute for potatoes, towards the close of the rains, when they come to perfection and the latter vegetable is dear" (*Gas. Beng., V., 307*). Firminger describes this as a "common but very excellent yam, as good as any perhaps in cultivation. The tuber is of a great size, crimson red on the outside, and of a glistening white within."

D. sagittata, *Royle (non Poir).*

Vern.—*Tair, tarur, tagur,* KUMAON; *Tarúr,* N.-W. PLAINS.

Habitat.—Met with in the North-West Himálaya.

Food.—The tubers are edible.

D. sativa, *Linn.; Kunth, Enum. Pl., V., 341.*

COMMON YAM.

Vern.—*Rátálu,* HIND.; *Ato sang,* SANTALI; *Ratálú,* PB.; *Chiná, godrí, kaun-phal,* BOMB.; *Gorkan, gorádu,* MAR., DEC.; *Ratálu* (*dhola* = cultivated white form, *al* a coloured), *yamskollung,* GUZ.; *Heggenasu,* KAN.

Grierson (*Bihár Peasant Life, 250*) gives the following Bihárí names for what appears several species of Yam, though by him placed under **D. sativa**:—*Latar,* north of the Ganges; *ratar* to the west; *atár,* north-west; *kathár,* south-west; in Patna and Gaya *ratálu*; in Tirhoot *phar*; and to the east *khamharna.* While regretting inability to arrange these names under their correct botanical synonyms, there seems no doubt they are names for yams, and it is interesting to have to add that **Mr. Grierson** furnishes the Bihár names for **Colocasia antiquorum** (the *kachchu*), as distinct from those above, which he says are yams.

References.—*Dals. & Gibs., Bomb. Fl. Supp., 92; Stewart, Pb. Pl., 229; Drury, Hand-book Fl. Ind. III., 274; Year Book, Pharm., 1878, 275; Beyt's Gujarat Agri., p. 53, appears to be describing three cultivated forms of this species; Lisboa, U. Pl. Bomb., 178; Birdwood, Bomb. Pr., 179; Bomb. Manual, Rev. Accounts, 101; Gas. of Mysore and Coorg, I., 55; Smith, Dic., 444.*

Habitat.—Cultivated over the greater part of India. Dr. Dymock, in a letter to the author, says there are several distinct varieties of this plant in

Bombay. Lisboa remarks that it is "wild and cultivated in India and the Archipelago." Dalzell and Gibson state that it is "the most common species cultivated." Cultivated in Chutia Nagpur by the Santals.

Medicine.—In the form of a powder it is used as an external application for ulcers.

Food.—The tubers are eaten cooked as a common article of diet. In Bombay this is the most extensively cultivated species; of Gujarat it is said: "Three varieties of yam (*Ratálu*) are grown here, a long and a small white tuber—both called *dhola*, and a purple tuber, *lal*. They are alike generally raised on the ridges of ginger fields, irrigated and manured. Duration in the ground from seven to two months." The "*ratálu*" is alluded to as also cultivated in Rewa Kantha and Kathiawar. The "*ratálu*" is said to be grown in Cawnpore, the seed for an acre being two maunds, and the produce 200 maunds. In the Hardoi Settlement Report (*p. 16*) it is stated that yam lands in the vicinity of towns fetch ₹50 an acre.

[*Wight, Icon., t. 815.*

Dioscorea tomentosa, *Kœnig.; Roxb., Fl. Ind., Ed. C.B.C., 729;*

Syn.—HELMIA TOMENTOSA, *Kunth;* and probably also D. TOMENTOSA, *Hohenhacker.*

Vern—*Chenyel, cháyena,* BOMB.; *Subba dumpa,* TEL.; *Kyway pin,* BURM.; *Uyala,* SING.

References.—*Kurz, Prel. Report, Pegu, XXII.; Dymock, Mat. Med. W. Ind., 2nd. Ed., 843; Sir Walter Elliot, Flora Andh., 169; Trimen, Cat. Ceylon Pl., 93.*

Habitat.—According to **Roxburgh** this is a native of the Circars, appearing in the rains. If the above synonyms be correct, it is possibly also a native of the West Coast of India at Travancore, Mangalore, &c.

Food.—The young shoots are eaten as greens in Bombay.

D. triphylla, *Linn.; Kunth, Enum., 392.*

Vern.—*Mándá,* MAR.; *Ts-iagri-nuren,* MAL.

References.—*Rheede, Hort. Mal., VII., t. 33; Dalz. & Gibs., Bomb. Fl., 247; Dymock, Mat. Med. W. Ind., 2nd Ed., 843; Birdwood, Bomb. Prod.; Year Book, Pharm., 1878, p. 275.*

Habitat.—Common in the Concan and in Malabar.

Medicine.—**Dymock** says the tubers are sometimes used to disperse swellings.

Food.—The tubers are according to **Graham** intensely bitter and intoxicating. They are said to have been eaten in Bombay during times of scarcity and famine. They have to be well boiled to destroy the acridity, but are even then not over-wholesome.

D. versicolor, *Wall.*

Vern—*Genthi, gajir, ganjira,* HIND.; *Dola álu, dudha álu, kanri, genti,* CHUTIA NAGPUR; *Githi* (Bijnor), N.-W. P.; *Genthi* or *genti gajir, ghanjin,* KUMAON.

References.—*Voigt, Hort. Sub. Cal., 653; Beng. Gaz., XVI., p. 53,* may be alluding to this species; *Atkinson, Him. Dist., 735; Econ. Prod., V., 98.*

Habitat.—A native of the Eastern Peninsula, from Monghyr to Kumáon, Nepál, Assam, Prome, and Tavoy.

Food.—**Atkinson** says of a wild yam found in Kumáon (which he may be correct in assigning to this species) that it "occurs in these provinces (N.-W. P.); the bulb on the stem and root is eaten as a vegetable; flowers in the rains. This climber is of considerable interest, as its large tubers furnish the deliciously fragrant yam which supplies a great part of the food of the Bhuksas in Moradabad and Bijnor when grain is scarce.

DIOSCOREA.

The plant is common throughout the forest; and its tubers, which grew to several pounds weight, are got at by digging from 2 to 6 feet. To remove their original acridity, they are always steeped for a night in ashes and water before being cooked."

CONCLUDING REMARKS.

Since the above was written some interesting facts in reply to a circular issued by the Government of India have been received from the various local Governments.

These in most cases have not, however, attempted to distinguish the various species, but treat of yams generically. From Burma it has been reported that in the Upper Chindwin District yams are cultivated and sold for 3·65lb (one viss) for 1 to 2 annas. Information is also furnished regarding Pegu where several forms are grown. Regarding Tharawaddy, Bassein, Shwegyin, Amherst, and Upper Burma: of Hanthawaddy it is stated that the cultivation of an acre costs R11 and the profit amounts to R50. Of Bhamo it is remarked, two kinds occur—a white and a red. "The white kind grows wild and the red is cultivated."

Of Madras similar reports have been received: of the Kistna District it is stated that the crop is planted out in January and harvested in August. The cost of cultivation is R20 per acre and the profit R30. The Collector of Cuddapah says that yams in his district are known as *nilwa pendalam*, and that they both grow wild and are cultivated.

GEORGE WATT,

Simla, December 1888. *Reporter on Economic Products.*

VOL. I.; PART II.; (NO. 12.), 1888-89.

SELECTIONS FROM THE RECORDS OF THE GOVERNMENT OF INDIA, REVENUE AND AGRICULTURAL DEPARTMENT,

BY THE

REPORTER ON ECONOMIC PRODUCTS.

Second Note on the Indian Fibres

REQUIRED BY

Her Majesty's Secretary of State for India; also for the Imperial Institute.

ARRANGEMENTS PROPOSED FOR COLLECTION, viz., by

It will be seen that the fibres here enumerated have been grouped into three alphabetical lists (according to the scientific names of the plants from which they are obtained); and it is only necessary to add that this classification has been adopted in preference to that followed in the original list, as bringing out certain points of commercial importance and administrative arrangement necessary for their collection. It may be added that the numbers given within parentheses are those of the Colonial and Indian Exhibition Catalogue, Indian Section. The proposed quantities to be indented for have been calculated so as to form five sets of collections—one exceptionally large being that intended for the Imperial Institute; the others for the Royal Botanic Gardens of Kew and Edinburgh and for the Chambers of Commerce in Manchester and Dundee.

FIRST CLASS.

Forest Department. Burma; Imperial Museum, Calcutta.

1. *(No. 900.)* **Annas sativa** *(Pine-apple fibre).*
This plant is fairly abundant in Bengal; but in some parts of Burma and the Himálaya it has run wild, and is indeed becoming a source of trouble. It yields a remarkably valuable fibre, which has not as yet been properly tested by experts. It could best be got from Burma, and I would suggest one maund being collected.

N.-W. Provinces; Imperial Museum, Calcutta.

2. *(No. 901.)* **Andropogon muricatus** *(Khas-khas).*
Calcutta might supply this. Quantity 24 seers from each locality.

But samples of this fibre should, if possible, be procured from Madras, as well as from Bengal. The Madras people use it for decorative purposes; and I suspect their form of the plant differs from the Bengal. It is darker coloured, and I think more odoriferous.

Imperial Museum, Calcutta.

3. *(No. 961.)* **Corchorus capsularis and olitorius** *(Jute).* *(Conf. with pp. 215 to 244.)*
This fibre is well known; but I would try to procure, as a favour, from **Mr. Cogswell,** or some other Jute merchant, five or six specimens of the longest available fibre. It can often be got 15 to 20 feet long; and

ARRANGEMENTS.

for Museum purposes this would be much appreciated. If procurable, it would also be of considerable value to have five or six samples of each of the better known commercial qualities or varieties of the fibre, such as the Bakratadi, Bhatial, Deora, Desi, Deswal, Jangipuri, Karinganji, Mirganji, Narainganji, Serajganji, and Uttariya.

I may take this opportunity of anticipating some of the results of **Messrs. Cross, Bevan, King and Watt's** report on Indian Fibres shown at the Colonial and Indian Exhibition. It was found that we are only on the threshold of a true knowledge of the properties and uses of jute fibre. Through the kindness of a friend, seeds of the two species named were procured, and germinated. At different stages of their growth the stems were cut, and the fibre examined. The results were not conclusive, as enough material was not available; but sufficient was seen to justify the conclusion, that if cut at different periods of growth, and treated by various processes, fibres of widely different qualities from those usually attributed to jute were obtainable. A fibre, which even some silk experts were deceived with, was shown, in which, for delicacy of ultimate filaments, gloss and softness could scarcely be distinguished from silk. These experiments might be materially advanced, were some jute merchant to procure, say, of two of the best known forms, a bundle of stems cut when two feet high, when four feet high, when the flowers have just appeared, and when the fruits have matured. Half the quantity in each case should be treated in the usual manner, and the fibres extracted as described under **Cannabis sativa** (*p. 176*); and the other half sundried, with the fibres attached to the stems. A series of such specimens would enable **Mr. Cross** to complete investigations that may open out new channels of usefulness for the jute industry.

(Since writing the above, **Messrs. Cross, Bevan and King's** report has appeared; and I have also published a paper on the subject of **Jute** in the Dictionary. It would be most important to get samples of the fibres yielded by all the species of **Corchorus**, similar to those described above, but at all events the fibres of **C. capsularis** should be kept distinct from those of **C. olitorius.**)

Madras; Bombay.

4. *(No. 914.)* **Grass (=Sedge) Mats,** *and Fibres used for*—

A constantly increasing trade is now being done in these mats. A special conference was held at the Exhibition regarding them, and a large number of gentlemen attended. The finer qualities of Midnapur mats were viewed as too expensive for a large trade being done in them; but the ordinary Calcutta floor mats were much looked at, and prices carefully enquired after. They are sold by the yard, in pieces about a yard in breadth; variously-coloured samples are highly approved of. I would recommend that this subject receive attention, and that samples of the mats made in Calcutta and Madras be sent with, say, 10 seers for each set of specimens of the sedge as it comes into the market, and 10 seers for each set of the sedge after it has been split in the manner in which it is used. From want of samples of all the grass-mattings, these fibres were not, if I recollect right, dealt with in the Colonial and Indian Exhibition report; but they would constitute a very desirable addition to the present collections. We employed at London the ordinary *durma* mats to construct native shops in the Exhibition. These were much admired; and it was freely admitted that if these could be imported at a cheap rate, they would be found useful for the floors of peasants' houses, and also for placing under corrugated iron roofs, &c., &c.. I would recommend that samples of these be now prepared, together

N.-W. Provinces & Oudh; C. Provinces; Assam.

ARRANGEMENTS.

with samples of the *durma* reed, both entire and cut open in the manner in which it is used. These *durma* mats should, if possible, be accompanied with a quotation as to the wholesale price at which they could be furnished.

Imperial Museum, Calcutta.

I do not think it would be desirable for **Mr. T. N. Mukharji** to undertake more than the collection of the Bengal matting-sedges and the mats made therefrom. The subject is of such interest that, I think, at some future date a special pamphlet might be issued from this office on mats, matting, and matting-sedges. If attention were, for the present, to be concentrated on collecting specimens and full particulars regarding the Bengal mats, a useful piece of work would be accomplished. **Mr. C. B. Clarke**, who has devoted much attention to the subject of matting-sedges (**Cyperus sp.**), wrote me that the surprising point was that some of the Calcutta mats were made of sedges that did not occur in Bengal. The supply of material must in such cases therefore be imported :—wherefrom is the point of interest. Were **Mr. T. N. Mukharji** to collect flowering specimens of the plants, from which the sedge fibre was in each case obtained, a scientific service of the greatest importance would be accomplished. *(Conf. with Dictionary Economic Products, Vol. II., 681.)*

Forest Department.

5. *(No. 921.)* **Hardwickia binata.**

This is not a very important fibre, since it is only useful for paper; and, as remarked under **Daphne**, it will scarcely pay to send bark fibres to the English paper-maker, with Esparto at £4 a ton—a sum probably less than the freight to England.

A use may, however, be found for this fibre ; and the minimum (24 seers) may be procured. The tree is fairly common in Behar, and plentiful in Western India.

Forest Department.

6. *(No. 922.)* **Helicteres Isora.**

The bark fibre from this bush is not of great value, but it has been recommended as a substitute for bast. It could be collected in Chutia Nagpur, and the minimum amount would be sufficient, *viz.*, 24 seers.

N.-W. Provinces & Oudh.

7. *(No. 937.)* **Pollinia eriopoda** *(now known as* **Ischœmum angustifolium,** *Hackel).*

The *babar* grass was admitted at London to be an excellent substitute for Esparto, but that at present prices it could not compete in the English markets.

Imperial Museum, Calcutta.

I would procure a maund or thereabouts, since some pains were taken in the report to investigate the properties of this paper fibre, and in consequence manufacturers may wish to examine it. The Bally Mills might be induced to furnish Government with the amount desired.

Forest Department.

8. *(No. 944.)* **Sterculia villosa** *(The Udal fibre).*

This strong fibre is much used for ropes, and may be obtained from any part of India. It is common in Chutia Nagpur.

I would recommend a maund of fibre being procured ; but it should not be platted into ropes, as is customary.

SECOND CLASS.

The following are the twelve special fibres regarding which detailed notes have now been prepared *(see Nos. 13 to 19).*

Forest Department.

9. *(No. 906.)* **Bauhinia Vahlii** *(Malu fibre). (Conf. with pp. 181 to 185.)*

This climber is very common in parts of Bengal, *e.g.*, in the Darjeeling lower forests and in Chutia Nagpur. There are perhaps few more hopeful fibres in India. **Messrs. Cross, Bevan and King** in their report deal largely with this fibre, pointing out that it is one of the few vegetable fibres

ARRANGEMENTS.

Imperial Museum, Calcutta.

that can be bleached, dyed, &c., by the same processes as wool. I would send 12 maunds for the Secretary of State's sets, and two maunds for the Imperial Institute. I have recently had some correspondence with **Mr. Peppo** of Chutia Nagpur, who, I understand, has been appointed the Local Agent for a Company formed to work this fibre. Collections might be purchased from him; but I would also ask the Forest Department to make sets; adding to those of fibre, samples of the ropes made of it, the leaves as used for plates, the leaves as used for bellows and bellowses, &c. The total collections, however, need not exceed 12 to 14 maunds of fibre. But they should show the fibre in all stages of preparation, and be accompanied with a full series of objects derived from the plant. The further note on this subject deals more fully with the properties of this fibre.

Madras; Bombay; N.-W. Provinces & Oudh; Punjab; also Imperial Museum, Calcutta.

10. *(No. 910.)* **Calotropis gigantea**- *(madar fibre. (Conf. with pp. 185 to 187.)*

This plant is being experimentally cultivated by the **Rev. A. Campbell** of the Santal Mission, Pokhuria, Gobindpur, Manbhum. If thought desirable, he might be requested to furnish the bark fibre. The plant is common all over India, and grows in a wild state; but it would be interesting to see whether it had, in any way, improved by cultivation. I would, therefore, suggest that of the wild plant in the vicinity of Calcutta, and of the wild plant in the North-Western Provinces (say near Lucknow), a maund of fibre be prepared from each locality; and that **Mr. Campbell** be desired to furnish a similar quantity of the bark fibre from his cultivated stock.

This plant also yields one of the best Silk-cottons. It is for this purpose that it is being cultivated by **Mr. Campbell**. I would therefore suggest that similar quantities of the floss from the seeds be procured from each of the selected localities mentioned above. This estimate would result in the following supply:

Floss and bark fibre from the wild Calcutta plant, say, of each one maund.		
Ditto	from wild Lucknow plant	ditto.
Ditto	from cultivated stock, Bengal	ditto.
Ditto	ditto Saharanpur	ditto.

In spite of all that has been written against the floss of this plant, it may still be viewed as having a hopeful future before it. Merchants at the Colonial and Indian Exhibition agreed that all that was necessary to bring it into a distinct commercial position was a large and uniform supply. I have suggested that the wild plant be collected from two localities, both because **C. procera** is the species likely to be collected in Upper India, and (even if this were not so) because it might be desirable to ascertain if the floss varies much in these extreme climates. I would even go so far as to suggest that a Panjáb, and even a Madras and a Bombay, series of sets of the floss might be added to those I have specially indicated; but for this purpose smaller samples would suffice, say 10 seers.

Mr. T. N. Mukharji might be desired to undertake the preparation of the samples of this fibre proposed to be procured from Bengal.

orest Department.

11. **Caryota urens.** *(Conf. pp. 187 to 189.)*

This palm, which is met with plentifully in Orissa, Madras, and Bombay, yields the *kittul* fibre of Ceylon, now so extensively employed in brush-making. The fibre usually shown is derived from the leaf-sheaths. It consists of cord-like fibres, of a dark-brown colour. At the Colonial and Indian Exhibition, samples of the ordinary *kittul* fibre were shown, as also a stronger, but similar fibre, said to have been extracted from the stems of this palm, and also of **Borassus flabelliformis**. The *kittul* stem

ARRANGEMENTS.

fibres were thicker and more flexible, while being stronger at the same time than those from the leaf sheath. A corset manufacturer called on me at the Colonial and Indian Exhibition, and asked if I could suggest a substitute for whale-bone, to be used in corsets. I thought of the palm fibres, and suggested that boundles of these might be sewn into the fabric of the corset. The idea was accepted as admirable. Knowing that Ceylon had a magnificent display of *kittul*, I referred the manufacturer to the Ceylon Commissioner. He, however, shortly after returned with the report that the Indian *kittul*, and especially that from the stem of the palm, was superior for his purpose. Unfortunately I could only tell him that the tree was plentiful, but that, while Ceylon was doing a considerable trade in *kittul*, no one in India had thought of collecting the Indian *kittul* fibre, or trading in it.

These facts may be assumed as indicating that a new industry might be started in India, in exporting *kittul* fibre. The palm is particularly abundant in the Bombay Presidency; and a maund-and-a-half or so might be procured, for the present collections, from the Bombay or Madras Forest Department.

For the Imperial Institute a complete set should also be prepared, which should embrace a series of all the objects made locally from the palm or its fibre.

12. *(No. 913.)* **Cocos nucifera** *(Cocoa-nut Palm). (Conf. pp. 191 to 214.)* — Madras; Bombay.

The Bengal coir fibre can easily be procured in Calcutta; but it would be desirable to see that average clean bright coloured specimens only were purchased. The dirty brown refuse shown by India at the Colonial and Indian Exhibition was laughed at by the dealers who came to examine it, when compared with the clean, long, firm fibre shown in various other courts. This, I believe, was an accident, due to the abundance of the fibre. Its claims to careful consideration were lost sight of amid the thousands of less known products that poured into our hands while preparing the exhibits.

The fibre is, however, well known; and the minimum quantity, 24 seers, is all that need be sent.

During the Exhibition I suggested that the textile-like leaf-sheaths might be used in harness manufacture, in corsets, &c., and as surgical splints. This idea gained some favour; and as the sheaths are at present thrown away as useless, I would recommend that, say, 60 carefully selected pieces be furnished, each about 1½ feet long and 1 foot broad.

In addition to the Bengal Coir, a large set of samples should be procured from South India. A very complete set of the coirs of India, and materials made from them on a larger scale than those proposed above, should be made for the Imperial Institute. For this purpose further particulars will be found in the pamphlet on the important fibres of India *(p. 191)*. — Imperial Museum, Calcutta.

13. *(Nos. 913a & 967.)* **Crotalaria juncea** *(Sunn-Hemp). (Conf. pp. 246 to 264.)* — Madras; Bombay; N.-W. Provinces and Oudh; Punjab; C. Provinces; also Imperial Museum, Calcutta.

From **Mr. Cross'** report it will be learned that this fibre possesses very special merits, and that the degree to which it might be introduced to the textile industries, has not as yet been appreciated. It affords a gun-cotton, superior in some respects to that usually prepared; and, unlike cotton, before being nitrated, it does not require to be put through an expensive process of carding and spinning.

I would recommend samples of this fibre to be procured from Bengal, from the North-Western Provinces, from Madras, from Bombay, and from Jabalpur. Jabalpur hemp is supposed to possess superior qualities to the ordinary Sunn-Hemp; indeed, some of the brokers, who visited the

ARRANGEMENTS.

Exhibition, stoutly maintained that it was afforded by a perfectly distinct species from that of the Bengal Sunn-Hemp. Of each of these local specimens, I would recommend not less than 20 seers to be sent for each collection; or, say, a maund-and-a-half of each fibre for the five collections.

I would propose that the discoveries brought out in the Dictionary article on Sunn-Hemp be made the subject of special enquiry, and large samples, say half a maund of each kind of Sunn, be set apart for the Imperial Institute. The reprint of the Dictionary article below will enable this subject to be dealt with fully *(p. 246)*.

Bombay; N.-W. Provinces & Oudh; C. Provinces; also Imperial Museum, Calcutta.

14. *(No. 923.)* **Hibiscus cannabinus.** *(Conf. with pp. 267 to 272.)*
This plant is extensively cultivated throughout the upper portions of Bengal and in Bombay, in place of the Sunn-Hemp of other parts of India. It is used for cordage; but by the fibre experts who visited the Exhibition it was viewed as worthy of more careful consideration. It could be readily procured in Chutia Nagpur; and I would recommend a quantity of say a maund being obtained from each of the provinces noted on the margin.

Botanic Gardens.

15. *(No. 925.)* **Hibiscus ficulneus.** *(Conf. with pp. 272 and 273.)*
This is closely allied to the preceding, but if anything, is a cleaner and better fibre. It might be procured from **Mr. Duthie**, as it is common in the North-Western Provinces and the Panjáb. It also occurs in Bengal.

I would propose that a maund of the fibre be procured.

16. *(No. 927.)* **Hibiscus tiliaceus.** *(Conf. with p. 273.)*
This bush yields a strong and useful fibre; and as it is one of the most plentiful shrubs growing on the marshy coasts of India, were a use to be found for it, the cultivation might be indefinitely extended in regions where nothing else will grow.

Forest Department.

I would recommend a maund to be procured from Burma, and the same amount from the Sunderbuns through the Forest Department.

The above **Hibiscus** fibres will be found to be discussed more fully in the special pamphlet below.

Bombay; also Botanic Gardens.

17. **Malachra capitata.** *(Conf. with pp. 273 to 279.)*
This plant occurs throughout the hotter parts of India, being particularly abundant in Bombay. I find by some mistake it was not described in the Colonial and Indian Exhibition Catalogue, although a large specimen, furnished by **Mr. Gupte**, was shown.

Once upon a time it was thought that Bombay might develop factories to utilize this fibre, in opposition to the Bengal Jute Mills. Other and more hopeful enterprises appear, however, to have driven the *Ranbhindi* fibre out of the Indian public mind; but it will most probably reassert its claims.

I would procure a maund of the fibre from Bombay, and a like quantity by cultivation from one of the Botanic gardens.

Assam; also Botanic Gardens.

18. *(No. 930.)* **Maoutia Puya** *(the Poi Rhea of Assam).* *(Conf. with p. 285.)*
The true properties of this plant, as compared with Rhea, have not as yet been settled. The samples shown at the Exhibition were not authenticated. They came as *Dan* Rhea and as Poi; but no botanical specimens accompanied them. I suspect that the former is perfectly distinct from either Rhea or Poi, and may prove a more useful fibre than either.

ARRANGEMENTS.

One of the faults, it might almost be said of rhea, is its great strength. It is not necessary to use, for ordinary textile purposes, so strong a fibre. A fibre a little less durable, but of the same fineness and gloss, which might be more easily cultivated, if possible be less exhaustive to the soil, and which would oppose less difficulty to its isolation from the stem, would at once displace rhea from its present position. I have on several occasions recommended this matter to consideration; and I would take this opportunity of repeating that, if the Assam Agricultural Department could afford the time to give this matter its careful consideration, important results might ensue. All the forms of rhea, *ban rhea*, and *poi* found in the Assam valley should, if possible, be cultivated, and botanical specimens in flower, of each species from which fibre is prepared, be carefully preserved. But if it be found impossible to cultivate the *poi*, care should at least be taken to furnish botanical specimens of all the plants of this class from which fibres are procured. The rough rhea-like fibres so closely resemble each other, that it is practically impossible to tell the one from the other.

I trust I may be pardoned urging this matter once more to the consideration of Government. I deem the present position of the new rhea industry as a critical one. In spite of all that has been advertised to the contrary, and in spite of the beautiful specimens of the fibre constantly thrust into one's hands, it cannot be distinctly stated that the obstacles to a rhea industry have been removed. One solution of the difficulty is to finally determine whether or not it be correct to hold out the hope that there may be a better rhea-like fibre in India than the one presently being experimented with. By 'better' I mean, of course, one that can be more readily utilized, and which would meet the same, or nearly the same, purposes. There are some 40 rhea, or allied rhea, plants in India. Instead of systematically examining these, all past effort has been concentrated in an attempt to conquer the difficulties met with in one species.

I would procure ten seers of each form of the so-called wild rhea for each of the four collections desired by the Secretary of State, and half a maund at least of each for the Imperial Institute set.

19. *(No. 932.)* **Marsdenia tenacissima.** *(Conf. with pp. .)*

Bengal Botanical Gardens; also Imperial Museum, Calcutta.

This climbing shrub yields perhaps the finest, in point of texture, and for its thickness the strongest Indian fibre. Only a small amount was shown at the Exhibition, but it was universally admired. It has a much more silky appearance than rhea, is devoid of the glossiness of that fibre, and is not near so brittle. It is known as "Rajmahal hemp." Possessing such properties, one cannot help being surprised that so beautiful a fibre should have, up to the present day, been entirely overlooked. One great difficulty exists, *viz.*, the stems afford but a very small amount of fibre, and at the same time the plant is nowhere cultivated, and thus only a limited amount can therefore be procured.

I fear this fibre must accordingly be cultivated, and that a few ounces for each collection is all we can hope to get for the present. But as this is perhaps the most valuable fibre in India, I think an effort should be made to cultivate it in one or two of our botanic gardens. The question is, can it be cultivated, and profitably? When cultivated, as much of the fibre as possible should be made over for the five collections here dealt with.

20. *(No. 941.)* **Sida rhombifolia.** *(Conf. with pp. 279 to 284.)*

Bengal Botanic Gardens; also

Of all the fibres shown at the late Exhibition, none attracted so much attention as this. Fortunately, through the fact that **Mr. T. N. Mukharji** had induced a native gentleman to cultivate the fibre in Eastern Bengal,

ARRANGEMENTS.

Imperial Museum, Calcutta, and Bengal Government.

with the view of furnishing samples for the Amsterdam, we had an admirable consignment at the Colonial and Indian Exhibition. I am speaking from memory, when I say **Mr. T. N. Mukharji** had been the means of having the fibre cultivated. Be that as it may, the eight small bales arrived too late for Amsterdam, and were discovered by me in the Revenue and Agricultural Office, Calcutta, when working on the Colonial and Indian Exhibition collections. They were at once picked out as, perhaps, the most hopeful samples in our collection. This expectation was more than realized. Applications came from every quarter for samples. One bale was sent to Dundee, another to Belfast; so that the fibre was examined both as a substitute for jute and for flax. I have expected the results of these experiments to be made public, but as yet have not heard from either manufacturing centres; but I am firmly convinced there is no more hopeful fibre in India than the soft silvery white fibre obtained from this plant.

I would suggest that **Mr. T. N. Mukharji** be asked to furnish the name of the gentleman who grew the fibre above alluded to, and that correspondence be instituted with a view to persuading him, if possible, to recultivate the fibre on behalf of the Government of India. A quantity of the fibre, of say 10 or 12 maunds, should be obtained *(see p. 283)*.

Madras.

Besides the samples of this fibre alluded to above, several Forest Officers sent specimens; and I refer to them here in case the suggestion offered be found impracticable,—**Mr. G. Richardson**, Buxa, and **Mr. Cherry**, Salem. The latter gentleman supplied **S. carpinifolia**, a fibre which differs but little from that of **S. rhombifolia.**

Assam; also Forest Department.

21. *(No. 946.)* **Villebrunea appendiculata.** *(Conf. with pp.*

I believe this may prove to be the ban-rhea of Assam, alluded to under **Maoutia**; and it is perhaps the best of all the rhea fibres.

The same remarks (as to collection) apply to it as given under **Maoutia.**

The following are the SILK-COTTONS which the Secretary has specially mentioned as worthy of being made the subject of separate enquiry.

Forest Department; also Imperial Museum, Calcutta.

22. *(No. 908.)* **Bombax malabaricum.** *(Conf. with pp.*

This common tree yields the *semul* or silk cotton of Bengal. While this is not serviceable for textile purposes, it has been used as a substitute for Kapok, and is sometimes even sold under that name. It does not possess the same degree of elasticity as the true Kapok (**Eriodendron**). Quantity required about 24 seers.

For the Imperial Institute I should make an extensive collection from every province of India, indeed from nearly every district, each sample containing 5 to 10 lbs.; in this way we might discover the variations in quality. Some are good, others useless. *(Conf. with Dict. Econ. Prod., I., 487)*

Forest Department; also Imperial Museum, Calcutta.

23. **Calotropis gigantea.** *(See p. 120 and conf. with pp.*

24. *(No. 912.)* **Cochlospermum Gossypium.** *(Conf. with pp.*

This tree yields one of the silk cottons or Kapoks of commerce. It is abundant in some parts of Chutia Nagpur. Quantity required say 24 seers.

Bombay Forest Department.

25. *(No. 918.)* **Eriodendron anfractuosum.** *(Conf. with pp.*

This yields the true Kapok fibre of Java, for which **Cochlospermum Gossypium** and **Bombax malabaricum** are employed as substitutes.

ARRANGEMENTS.

This fibre would have to be procured from Bombay. The tree is said to be abundant, for example, in South Kanara. A large trade might be done in this fibre, a mistake having hitherto been made in sending *Semul* (**Bombax**) to England under the name of Kapok.

I would propose a maund of the clean floss, freed from the seeds and pods, to be procured. For further particulars regarding Kapok and the Silk-Cottons generally, see the pamphlet No. 19 of these Selections.

THIRD CLASS.

The proposed special pamphlet on Fibres (Nos. 13 to 19), frequently alluded to above, would deal mainly with the fibres from 9 to 25 inclusive; but there are others in the present list which might fairly well be taken up in a second pamphlet. Such a pamphlet would deal with those enumerated above (1 to 8), which it has been proposed should be mainly collected by **Mr. T. N. Mukharji**, the Assistant Curator, Imperial Museum, Calcutta. Any information which he might be good enough to furnish would be incorporated, such as the results of his inquiry into the sedges used in mat-making. But, besides the lists (1 to 8) which I have suggested he should commence work on at once, there are others, some of which, I fear, we can only procure good samples of, if the aid be called in of the Botanic Gardens, as these fibres would have to be cultivated. These I would propose also to deal with in a second pamphlet, to which allusion has been made; but anticipating approval of the suggestion to have certain of these fibres cultivated, I give brief notes here regarding the more important of this third series.

26. *(No. 896.)* **Abroma augusta**. *(Conf. with Dict. Econ. Prod., Vol. I., 8.)*

Botanic Gardens.

May be obtained from Bengal, the North-Western Provinces, or Assam. May have to be specially cultivated to secure the desired quantity, *viz.*, about a maund.

Imperial Museum; also Botanic Gardens, Calcutta.

Dr. King might be invited to cultivate and prepare this fibre.

27. *(No. 898.)* **Agave americana** *(American Aloe)*.

Good samples of this fibre were sent from Hazaribagh Jail and from Madras to the Colonial and Indian Exhibition. Quantity now required, one maund; but it seems desirable to cultivate the plant.

Botanic Gardens, N.-W. P.

28. *(No. 899.)* **Agave vivipara** *(The Bastard Aloe)*.

Carefully-determined samples of this fibre have not as yet been exhibited. I suspect it may prove a finer quality than No. 26. The plant is common in the North-Western Provinces; and perhaps **Mr. Duthie** of Saharanpur might be asked to procure, say, a maund of this and of the preceding as well, so that the two species might be authentically compared.

The greatest possible confusion exists as to the relative properties of the fibres of **Agave americana** and **A. vivipara**, which can alone be solved by having the fibres prepared from botanically determined or carefully cultivated plants. *(Conf. with Dict. Econ. Prod., Vol. I., 134.)*

Forest Department; also Botanic Gardens, Calcutta.

29. *(No. 909.)* **Broussonetia papyrifera** *(Paper-mulberry)*.

Dr. King or **Mr. Duthie** might be desired to furnish the samples, as in the gardens under their respective charges the plant has been, and may still be, under cultivation. **Dr. Brandis** held a very favourable opinion regarding the fibre obtained from this plant; and, if I mistake not, suggested its cultivation as a paper-fibre in Burma. A reference might be made to the Forest Department on this subject, since the supply might be more economically furnished by Burma. Quantity required, a maund-and-a-half. *(Conf. with Dict. Econ. Prod., I., 538.)*

ARRANGEMENTS.

Madras; N.-W. P.; Punjab; Central Provinces; Bengal; also Imperial Museum, Calcutta.

30. *(No. 911.)* **Cannabis sativa** *(Hemp). (Conf. with Dict. Econ. Prod., II., 107 and 118.)*

I would recommend that two maunds of the hemp stems from the Rajshahye *ganja* plantations; two maunds from the Central Provinces *ganja* plantations; and two maunds of the wild plant from Bengal, and two maunds, say from Simla, be procured. Such a quantity would put at rest the question as to whether the fibre and narcotic cultivation could or could not be combined. It would be out of the question to ask that the plants from the cultivated stock should be cut before the period when the narcotic is collected, since that would vitiate any idea of a combination of the two industries. But it would be satisfactory to know whether the *ganja*-yielding stock forms fibre; and with this object a seer of stems might be procured before the flowers appear and another seer while in flower, in each of the above named regions of narcotic cultivation, in addition to the dried stems obtained after the *ganja* has been collected.

At the same time it would also be desirable to ascertain *when* the fibre forms in the wild plant, for in many parts of India **Cannabis sativa** is a plentiful weed. If this wild stock yields fibre, it might be utilised. It would, therefore, be desirable to have one of the maunds of dried stems collected from wild plants, cut before the flowers form, and the other after they have formed. I should be glad, if desired by Government, to procure the Simla samples; but arrangements would have to be made to get that suggested from Bengal. I do not think it would be necessary to prepare more than half the quantity of the fibre from the stems. After cutting, if half the stems were simply sundried, they might be tied up in tight bundles and consigned with the rest of the collections to England. **Mr. Cross** and other experts would then be able to judge as to the degree to which fibre is formed in the stems of the narcotic-yielding hemp and of the wild hemp plant of India. I was repeatedly told by experts at the late Exhibition that we were neglecting this most important source of fibre; and it would save much unnecessary correspondence in future, were the matter to be placed in a definite manner before the fibre experts of Europe. I would further suggest that the Government of the North-Western Provinces be invited to procure two or three maunds of the different qualities of *Himalayan grown hemp fibre.*

Such a series of samples would greatly help to decide whether the further step was desirable of experimenting once more with hemp fibre cultivation. In the Godavery district it would appear hemp is actually cultivated for its fibre. An account of this subject will be found in the Gazetteer. If there be no mistake arising from the use of the popular word hemp in place of sunn-hemp or Bombay-hemp, this is an extremely valuable fact, as it would prove that hemp fibre can be grown in India. A set of collections should be procured from Godavery, say 3 maunds of fibre; but in case of mistake, the Collector or some other local officer should be invited to first send a small sample for inspection, as also a dried specimen of the plant from which it is obtained. If after examination of these samples it is found that hemp is actually grown in Godavery, then the suggested larger collection might be made.

Forest Department.

31. *(No. 915.)* **Daphne papyracea.**

This yields a remarkably strong fibre for paper (Daphne or Nepal paper). It would never pay, I fear, to export this fibre, however, for paper-making; but it is one of our strongest paper fibres, and is admirably suited for felting purposes, and there is no knowing to what new uses it might be put. It can be very conveniently got from Darjiling; and I would recommend a maund or two of the fibre, and a few sheets of the best quality of the native-made paper, to be procured for the present collections.

ARRANGEMENTS. Punjab Forest Department.

32. *(No. 920.)* **Gerardinia heterophylla** *(Nilgiri Nettle).*

There are two species of Gerardinia that yield the remarkably strong fibre known in commerce as Nilgiri Nettle. **G. heterophylla** is the form met with on the Himálaya, and **G. zeylanica** on the mountains in South India. The former could be procured at Darjiling or Simla, and the latter, perhaps most conveniently, from the Glen Rock Company, Wynaad, if that Company were found willing to prepare the same. I would recommend that a maund each of these fibres be procured, since in the event of a possible future trade it would be desirable to know whether the Himálayan was superior or inferior to the Nilgiri fibre. I regret that we were at the Colonial and Indian Exhibition unable to determine this point; since authentic specimens not having been procured, we could not tell which we were experimenting with. If collected from the two local extremes indicated, there could be no possible mistake.

C. Provinces.

33. **Linum usitatissimum** *(Flax).*

A recent Despatch received by the Government of India from the Secretary of State suggests the desirability of experiments being instituted in India with flax, similar to those described above for hemp. **Mr. Cross** proposes in a letter addressed to the Secretary of State to test the samples so procured, in order to discover whether or not the linseed oil plant of India does or does not form flax. Many years ago the Honourable East India Company devoted much attention to the subject of flax and hemp cultivation, and even imported Russian and other cultivators to conduct the experiments. The effort was finally abandoned, even although some of the reports then issued seem to indicate a certain degree of success. It would, however, be of the greatest value to have the subject reinvestigated by the modern scientific methods of treating the stems. With this object in view it would seem sufficient to invite the Government of the Central Provinces to take this matter in hand. Half a maund of ordinary linseed stems should be collected just before flowering, and half a maund after the seed crop has been collected. A small plot of land might also be sown with the ordinary linseed, at least twice as thick as is customary for seed cultivation. In this way the plants would be encouraged to grow lengthwise, instead of branching, as they do, when grown for seed. One-half the cultivated crop should be pulled up by the roots just as the flowers begin to form. These should be dried and thereafter deprived of their leaves and carefully baled. With the other half the crop should be allowed to form fruit, and be thereafter treated in the same manner as the first.

A careful record should be preserved of the dates of sowing and reaping, the nature of the soil, the method of cultivation, &c.; and a few pounds of the seed that was actually used should be reserved for similar cultivation in England. The results obtained by such experiments would prove whether the currently reported non-flax production in India was due to defect in the seed stock, or to the conditions of cultivation, while the stems obtained from the ordinary linseed crop would reveal whether or not seed and fibre cultivation could be combined.

It has been thought desirable to suggest experimental cultivation in one province only for the present; and it may be of value to quote here the opinion of **Dr. Royle** on this subject: "Of all parts of India, there are none that appear to me better suited to the growth of flax than the Saugur and Nerbuddah territories, as the soil is rich and prolific, and the climate a medium between the extreme moisture of Bengal and the dryness of the North-West Provinces." **Messrs. Duthie and Fuller** say: "Numerous experiments have been made within the last forty years

ARRANGEMENTS.

in growing flax in India, and very considerable success was obtained by a Belgian flax grower in Tirhoot with seed which had been imported from Europe But it is improbable that flax culture could be extended on any other system than that followed by indigo planters, under which the grower receives a cash advance at sowing time, together with a guarantee that his crop will be purchased at a fixed price. Flax fibre would be useless to a cultivator, unless he was certain of gaining a sale for it. It does not seem that any energetic attempts have been made to extend flax culture on this system; and what efforts have been made to promote it have been confined to experiments which have indeed proved the possibility of successful flax growing, but have given native cultivators no immediate incentive to undertaking it." This is a much more favourable view than **Royle** held, although in elaborately sifting all the reports which had appeared, he struggled to make the most of the position. He admits that had the East India Company's efforts and those of the Flax Company (founded by a **Mr. Rogers** of London and superintended by **Mr. Deneef**, the Belgian farmer, who came to India for the purpose) proved absolutely successful, we should now have had in India a recognised flax industry, instead of all trace of the cultivation having disappeared from the very districts where it was most vigorously prosecuted. Opinions seem about equally divided as to whether or not flax and linseed cultivation can be combined; but the majority of writers agree that if this cannot be done, we have in India many other fibres that can be more profitably cultivated than flax by itself. The experiments which might be performed now, it would seem, should aim at proving or disproving this position more than in discovering whether on certain plots of ground in selected provinces a good and useful fibre can be produced. Long ago the Belfast Chamber of Commerce observed that, "as India annually exports nearly 100,000 quarters of seed to Great Britain and Ireland, it has been calculated that the plants which produced this quantity of seed would yield annually at least 12,000 tons of fibre value, say, £ 500,000; all of which goes to waste." India exports nowadays between 8 and 9 million cwt. of linseed; and if the statement quoted above be correct, fibre to the value of several million pounds sterling is being annually wasted. It is opinions of this nature that would seem calling for final disposal before the possibility of improvements in methods of cultivation, in quality of seed stock, &c., should be taken up. Do the oilseed-yielding stems, as grown in India, contain a useful fibre; and if not, could this result be attained by improvements that could be commended to the Indian cultivator with any prospect of their being accepted? These seem the questions to be solved long before extensive inquiries are instituted as to the districts of India where a profitable flax industry might be prosecuted as distinct from that of the oilseed production.

Mr. Cross' generous proposal to co-operate in the performance of renewed flax experiments will be found detailed on page 31 of his Report on the Fibres of India. He wishes to have simultaneous cultivation in India and England of Indian and European seed in order to discover whether the former improves in Europe and the latter degenerates in India. Such experiments would establish definite ideas regarding the influences of the Indian climate on the production of flax.

Assam & Bengal.

34. *(No. 931.)* **Marantia dichotoma.**

This plant yields the bark made into the *Shitalpati* mats. These were much admired in London; and a mat, together with a bundle of the stems, might be added to each of the five collections here dealt with. It is highly probable other and entirely new purposes may be found

ARRANGEMENTS.

for this fibre, such as the manufacture of hats, table mats, and straw braids, &c.

The plant is common in Eastern Bengal, Cachar, and Assam.

35. *(No. 938.)* **Saccharum Sara** *(Munj grass).*

N.-W. Provinces & Oudh.

As far as the properties of this grass as a paper material are concerned, the remarks given under **Pollinia** (*No. 7*) apply only in a less degree. The mats, &c., made of this grass, and shown at the Colonial and Indian Exhibition, attracted however the greatest attention; and I would therefore recommend that, say, a maund of the grass and pieces of the carpets, mats, ropes, and also baskets, &c., made of it, be procured from the Delhi Jail. The Superintendent of that Jail furnished the late Exhibition with a series of sample mats, and might be induced to again prepare five sets for the purpose of the present collections, an exceptionally good and large one being furnished for the Imperial Institute.

36. *(No. 935.)* **Pavonia zeylanica.**

Forest Department.

This fairly abundant bush in the North-West Provinces, Sind, Bombay, and Madras yields a fibre of excellent quality, somewhat resembling the fibres from the species of **Hibiscus** already described. It is, if anything, of a finer texture, softer and whiter, and stands a good chance to come into commercial use as a substitute for **Hibiscus**, and even for jute.

37. *(No. 947.)* **Yacca gloriosa.**

Madras.

A strong and admirable fibre; a maund might be obtained from Madras.

I beg, in conclusion, to point out that I have in the above enumeration practically rearranged only my former Memorandum into three sections—1st, Fibres, which I think **Mr. T. N. Mukharji** (Assistant Curator, Economic Museum, Calcutta) might commence to collect at once, with a few that he has suggested should instead be handed over to the Forest Department; 2nd, Fibres, the collection of which might be delegated to Provincial authorities (the further detailed pamphlet on certain of the more important fibres of India indicates the provinces that might be invited to supply; but the present abstract statement will allow of immediate action being taken); 3rd, Fibres, which should be experimentally cultivated at the Botanic Gardens or Experimental Farms.

It is only necessary to repeat that my estimates of quantities, formerly given, were framed on the supposition that it might be deemed desirable to make at once twelve sets, not four; after a conference on this subject with the Officiating Secretary, my quantities have been now adapted so as to suit five sets, the fifth and largest being for the Imperial Institute.

The quantities originally suggested, however, have not been seriously disturbed; but if anything, they have been reduced. It may be explained that the varying proportions indicated in the foregoing notes are due to the fact of some fibres being more valuable than others; and this fact, together with the differences in the weight, have rendered an arbitrary quantity not desirable. For example, 4 lbs. of **Calotropis gigantea** floss would be a disproportionate quantity of that fibre as compared with 4 lbs. of **Bauhinia Vahlii.**

SIMLA,
6th September 1888.

GEORGE WATT.

ARRANGEMENTS.

VOL. I.; PART II. (No. 13); of 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

In connection with the operation of collecting fibres for the Imperial Institute and for the Chambers of Commerce of Manchester and Dundee and the Royal Botanic Gardens of Kew and Edinburgh, the Secretary to the Government of India in the Revenue and Agricultural Department desired the undersigned to prepare notes regarding certain important fibres on a more detailed scale than has been given in No. 12 of the current volume. With this object the present number and the succeeding six numbers of the Selections have been prepared. These are as follows: No. 13, **Bauhinia Vahlii, Calotropis gigantea,** and **Caryota urens**; No. 14, **Cocos nucifera**—the Cocoa-nut; No. 15, **Corchorus**—Jute; No. 16, **Crotalaria**—Sunn-hemp; No. 17, Malvaceous fibres; No. 18, Rhea and allied Rhea fibres; and No. 19, Silk Cottons. It is hoped these notes may prove of some value to the officers who may be desired to prepare the fibres.

GEORGE WATT,

Simla, November 1888. *Reporter on Economic Products.*

NOTE.—The serial numbers given to the fibres in this and the subsequent sections of these Selections (dealing with fibres), are those used in No. 12 of the present volume.

VOL. I.; PART II. (No. 13); of 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

Some of the more Important Fibres of India.

9.—**Bauhinia Vahlii**, *W. & A.*; LEGUMINOSÆ. 9.

Dictionary, Econ. Prod., Ind., Vol. I., 424.

Vern. names.—*Málú, maljan, jallur,* HIND.; *Chehur,* BENG.; *Jom,* SANTALI; *Lama, rung,* KOL.; *Shioli, mahúl,* URIYA; *Sihár, mahalan,* C. P.; *Borla,* NEPAL; *Sungang,* LEPCHA; *Taur,* PB.; *Chambolli,* DUK.; *Chambúra, charbor,* MAR.; *Paur, pahúr,* GOND; *Adda,* TEL.

Habitat.—An extensive climber, found throughout the Lower Himálaya and everywhere on the hills of the great tableland of India southwards to Madras and south-eastwards to Tenasserim.

USES. THE USES OF THIS CLIMBER are, perhaps, more varied and extensive than are those of any other forest plant. It yields a soft India-rubber-looking GUM, which, with age, hardens and becomes brittle. The SEEDS are eaten raw or cooked, and the LEAVES are universally employed by the hill tribes as substitutes for plates on which to eat their food. But the most valuable product of the plant is its BARK FIBRE. This is extensively utilized by the people of India for the purpose of making strong and useful ropes. Mr. Atkinson says: "This creeper often attains a length of 40 to 50 feet, and is generally cut down in July-August, though it may be cut at all seasons. In its natural state it is used for rope-bridges, but to manufacture rope from it, the outer bark is peeled off and thrown away, and the inner coating is steeped in water and twisted when wet. A large creeper will produce a maund of this fibre known as *selu*. Before being used, the bark is boiled and beaten with wooden mallets, which renders it soft and pliable enough for being made into rope and twine, used in the erection of rope bridges, for thatching, stringing cots, and the like." The same facts were some time before published by Captain Huddleston in his Report on Hemp in Garhwál. This fibre (*málú*) was first shown in Europe during the Great Exhibition of 1851, since which date it has found a place in all Museums and Exhibitions of Indian products.

Gum. Seeds. Leaves. Fibre.

Ropes.

FIBRE.

Paper. The late Mr. Routledge urged its claims as a paper fibre, but, while it is admirably suited for that purpose, it will most probably be found to be too valuable.

Of the fibres furnished to him by the Director of Kew Mr. Routledge

9. reported: "**Bauhinia Vahlii** is decidedly the best, possessing the characteristics of strong linen rags, *i.e.*, of coarse flax and hemp; the raw bark is worth £7 to £8, possibly £9, per ton; the bleached stock £20 to £22." In **Mr. Routledge's** experiments the "green" yield of fibre was 60 per cent. and the "bleached" 54·7 per cent.

In connection with the Conferences held during the Colonial and Indian Exhibition (in the Commercial Rooms of the Indian Section) enquiry into the properties of this fibre was prosecuted with great advantage. Fortunately large supplies had been sent to London, and it became thus possible to furnish gentlemen, desirous of investigating its properties, with samples of sufficient bulk to admit both of chemical and practical tests. Several gentlemen (in particular **Mr. Wilson** and **Mr. Cross**) independently worked out its properties—the former adding to our knowledge of the fibre by showing that in the process of cleaning a rich brown colour was extracted that might fairly be expected to add to the return of working the fibre. This colour **Mr. Wilson** employed in dyeing silk, and produced some elegant shades by different reactions. But, perhaps, the property of greatest merit as yet brought to light is connected with the discovery that the *málú* fibre can be bleached and dyed by the same processes as wool, a fact that would admit of this fibre being worked along with wool, in mixed fabrics, in a manner not possible with cotton, or in fact with any other known vegetable fibre (except perhaps rhea). It loses weight rapidly, and is resolved into its ultimate cell-fibres if bleached with alkalies in the manner adopted with cotton. **Mr. Cross** has confirmed these results, and in the report by **Cross, Bevan, King,** and **Watt** (recently published by order of the Secretary of State for India) the length of the fibre is given as 2-3 m.m. The ultimate fibre-cells of jute are only 3 m.m., while those of flax are as long as cotton—namely, 40 m.m. This length of fibre-cells is of great importance in the estimation of the commercial value of a fibre; for while the actual fibre with which the manufacturer has to deal consists of a variously united bundle or aggregation of fibre-cells, the process of washing and bleaching, &c., tends to reduce this complex fibre into its ultimate particles, and the point is thus gradually approached when the durability of a textile will depend on the length and character of the ultimate cell-fibres. Indeed the difficulty with Jute, for example, consists in the fact that if completely bleached it becomes "rotten," that is to say, all the non-cellulose materials that held its cell-fibres together have been removed, and fibres less than a tenth the length of cotton remain for the manufacturer to spin. In the report just alluded to it has been shown that by hydrolysis (*e.g.*, the process of purifying by means of water or water aided by an alkali) fibres lose weight. Bleaching is the employment of a reagent that will intensify this action and thus shorten the duration of the process either by the chemical transformation of a colouring into a colourless constituent, or by its reduction into a soluble substance that may be removed by washing. The loss of weight occasioned by this purification and the condition in which it leaves the substance, becomes one of the most important factors in determining the value of a fibre. The hydrolytic excellerator most generally employed with vegetable fibres is some alkali, and for practical purposes in the laboratory a solution of caustic soda (1 per cent. Na_2O) may be used. The loss after boiling in this solution for five minutes may be ascertained and by a second experiment the loss after one hour. In the case of some fibres a stage is reached after which the loss is very inconsiderable; with others it continues or even increases. These are, therefore, points of the first importance. In the hydrolysis of animal fibres washing with soap or very dilute alkalies is followed by the treatment with an acid, generally sulphurous acid. The behaviour of vegetable and animal fibres under hydrolysis is thus opposed. The alkaline treatment that will purify the majority of vegetable fibres will destroy the animal, in other words, what is applicable to animal fibres is, generally

Dye.

Bleaching and Dyeing of Malu Fibre.

speaking, inapplicable to vegetable. **Mr. Cross** did not pursue the enquiry into the comparative loss or destruction of vegetable fibres under the acid treatment, but he has furnished a most valuable table showing the effect of five minutes' (*a*) and of one hour's (*b*) boiling with sodium alkali. By way of contrasting the *málú* fibre with another well known fibre which belongs to the same natural order of plants, it may be here stated that **Crotalaria juncea**, *sunn*, by (*a*) lost in **Mr. Cross'** experiments 8·3, by (*b*) 11·7; while *málú* by (*a*) lost 38·9, by (*b*) 61·6. Thus by the alkali process the *málú* may be said to lose nearly half its weight and compares, therefore, most unfavourably with the common *sunn* hemp. As a practical fact, however, it is a strong and almost equally durable fibre, while it possesses a soft woolly appearance that favours immensely its application to textile purposes where similarity to wool is the aim. As a matter of fact, it would appear to be possible to bleach and cleanse the *málú* by acids without anything like the loss shown by the alkali process, and it remains, therefore, to be determined how far the acid bleaching resolves it into its ultimate cell-fibres. The bleaching may be but a chemical change from a coloured to a colourless state without serious loss of weight. Commenting on its possible utility the authors of the report quoted above say: "So in a like manner a lower position has been assigned to the *málú* fibre (the fibre of **Bauhinia Vahlii**) than it may practically be found to deserve. The ultimate fibres are short and lignified more or less; but in spite of these objections the fibre possesses properties that may commend it to certain industries." The recent chemical and microscopic investigations conducted by **Messrs. Cross, Bevan, and King**, have advanced very materially our knowledge of the properties of the Indian fibres, but the manufacturer has now to take up the reins and carry the enquiry to final and practical issues. **Dr. Roxburgh**, at the beginning of the present century, examined the fibres of India from what might be called a practical standpoint. He had them carded and spun into yarns and ascertained the weights they would bear both in the dry and the wet state, tanned, tarred, or white. These experiments have never been reperformed, but his results would appear to be almost at variance with those recently arrived at in **Mr. Cross'** laboratory. Instead of advancing **Crotalaria juncea** (the sunn hemp) into the list of fibres of first importance and relegating **Abroma augusta** into that of the second and **Bauhinia Vahlii** into that of the third, **Roxburgh** placed **Abroma** before **Crotalaria** and **Bauhinia** practically equal with **Crotalaria**. Thus a line of sunn-hemp when fresh and white broke with a weight of 68lb, with 69lb when tanned, and 60lb when tarred. After having been macerated in water for 116 days, the clean fibre was found to be rotten, the tanned line was in reality improved, as it only broke with a weight of 68lb, and the tarred rope had degenerated, since it broke with a strain of 45lb. The same experiments were performed, with **Abroma**, the white fresh line broke with 74lb, tanned with 58lb, and the tarred with 44lb, while after 116 days' maceration the white cord far from being rotten only broke with a strain of 38lb, the tanned with 54lb, and the tarred with 50lb. The white line of **Bauhinia** sustained a strain of 69lb or a little more than that of **Crotalaria**, but like the *sunn* was found to be rotten after maceration. According to **Messrs. Cross and Bevan's** experiments the amount of cellulose in a fibre is a feature of the first importance in ascertaining its textile property: **Crotalaria** contains 83·0, **Abroma** 80·0, and **Bauhinia** only 52·5 per cent.

9.

Hydrolysis.

Practical Tests of strength.

The above brief review of the position enquiry has been carried to, with regard to the *málú* fibre, has been here given in the hope of diverting public attention from extraneous questions. It is credibly reported that a company has been established in India to work this fibre and, if so, the parties interested in this new venture have doubtless satisfied themselves as to the validity of the reports which took their birth regarding

9. malu fibre during the late Exhibition. It would seem a just inference to say that if *málú* fibre suffers as much under the acid or any other process of hydrolysis as under the alkali treatment, the sooner the subject is abandoned the better. But, on the other hand, if after being bleached and purified it remains a workable fibre, there would seem to be good grounds for the expectation that it may have a considerable future as a fibre to be used along with wool.

Collections might be made by Forest Department and Imperial Museum.

To ascertain the properties of this fibre it would be necessary to send to a manufacturer not less than a hundred weight, and it would be a good preliminary step, if found practicable, to induce the native collectors to discontinue the practice of twisting the raw fibre into coils. These occasion much trouble and injury to the fibre before the bleaching stage can be reached. The fibre might be collected anywhere within the area of distribution, given in the opening sentence of this note, but perhaps it could be most readily and economically procured in Chutia Nagpúr.

NOTE.—For the purpose of the present collections a maund from each of the following localities would suffice—Chutia Nagpur, Darjeeling Tarai, and Burma.

10.—Calotropis gigantea, *R. Br.*; and C. procera, *R. Br.*; ASCLEPIADEÆ. *Dictionary, Econ. Prod., Vol. II., 34—49.*

THE MADDER.

Vern.—*Ak or árk*, HIND.; *Akanda*, BENG.; *Ahauna*, SANTAL; *Akra rúi*, BOMB.; *Akado, jhadá*, GUJ.; *Bij-elosha*, SIND; *Yercum, erukha*, TAM.; *Jilledu, yekka*, TEL.; *Erukku, erica*, MAL.; *Kadráti*, GOND.; *Ushar, oshmor*, ARAB.; *Khark*, PERS.; *Arka, alarka*, SANS.; *Mayo-beng* BURM.

Habitat.—There are two species, **C. procera** being most abundant in Northern India, and **C. gigantea** taking its place in the south and east. They are extremely plentiful bushes, and although nowhere cultivated otherwise than experimentally, are used by the people for many purposes. The sap yields a form of GUTTA-PERCHA and is medicinal, and so also is the ROOT BARK. The bark of the stem affords a FIBRE, and the seeds are tipped by a coma of hairs or FLOSS which is extensively used in India for stuffing pillows. (See the remarks under Silk-cotton No. 19.)

USES OF THE PLANT.

Gutta-percha. Medicine. Fibre.

Fibre from the Bark and the Floss from the Seeds.—Much has been written regarding this fibre, but the expense and difficulty of separating it has hitherto proved practically insurmountable. A proposal has been made to have the plant cultivated, and this is actually being tried in Chutia Nagpúr. The primary object in view is to ascertain whether it is possible to improve the FLOSS, and should this be attainable, then to find out whether the cost of cultivation could be so amply recovered as to justify its being systematically grown. Hitherto the supply of the floss has been drawn from the wild plant, and although in this condition the plant occurs everywhere, the labour of collecting the floss over a wide area has hitherto proved too great to admit of a large and regular trade. If, as is likely to be the case, the quality of the bark fibre is found susceptible of improvement by cultivation, the industry of growing the plant may be rendered remunerative by the joint production of both floss and fibre. The bark fibre is so extremely valuable that it seems desirable that the experimental cultivation of the plant should be attempted in several regions, the more so as it may be grown on waste lands where nothing else will thrive.

FLOSS.

FIBRE.

Examination of the Fibre.

Mr. Cross, in his valuable chemico-microscopic experiments (to which reference has been made in some detail under the above note on **Bauhinia Vahlii**), has confirmed all the previous opinions regarding the value of this fibre. He has placed it in his first section, *viz.*, of fibres suitable for the higher textile purposes. He has shown it to possess 76·6 per cent. of cellulose, and to give up under 5 minutes of hydrolysis only 13·0 per cent. of its weight, and even after boiling in the alkaline solution for an hour, to lose

10.

only 17·6 per cent. The fibre-bundles when decorticated mechanically are only 8-16 inches long (this shortness being probably due to the isolation that takes place at the joints of the stem), but the ultimate fibres are, comparatively speaking, long, *viz.*, 10-30 m.m. and have tapering ends. The bundles are easily divided, so that a thread of great strength, and yet of the most delicate structure, may be spun of them. By nitrating the fibre a substance is produced which can with difficulty be distinguished from silk. It has all the gloss and softness of silk, and so promising is this chemically-changed fibre, that it may safely be affirmed that the price likely to be obtained for it would richly reward all the expense entailed in isolating and cleaning the fibre. *In view of these expectations it might be desirable, before cultivation is attempted, to ascertain if there are different qualities of the wild plant.* This would have the advantage of securing the best stock to be experimented with under cultivation. To accomplish this object the bark fibre might be collected from two or three important centres, *e.g.*, from Calcutta, Lucknow, and Burma. The dry regions of India might be even better represented by Rájputana than Lucknow. But as the plant is abundant everywhere, the district where it may most conveniently be collected would serve the present object, which is to ascertain whether the plant yields more or less, and a better or inferior fibre in a dry than in a damp region. The Rev. A. Campbell of the Santal Mission, Chutia Nagpúr, is the gentleman to whom reference has been made as having attempted the cultivation of the plant. To compare with the wild stock from the above regions, it might be desirable to obtain (if available) a consignment of the bark-fibre from Mr. Campbell's cultivated plant. *From each of the above mentioned localities not less than one maund should be obtained and cleaned as far as local applicances will admit of.* The best course to separate the bark-yielding fibre appears to be to select the straightest and longest branches with, if possible, long interspaces between the leaves. It is not known whether young saplings or fairly mature twigs afford the best and largest amount of fibre. Indeed, from its being a perennial plant and one which flowers all the year round, it may be difficult to ascertain the age of a twig, so that some share of past failures may have been due to mixed consignments. The age, therefore, at which the plant should be cut is one of the points that experiment alone can determine, but speaking from experience gained with other plants, it may be said there is generally a period at which they should be collected, before which the fibre is immature and after which it is lignified or rendered hard, brittle, and almost useless. Having selected the twigs, they should be cut and allowed to dry for 24 hours. On the second or third day after cutting they should be taken up individually and beaten, especially at the joints. The workman should then bite through the bark about the middle of the twig, and holding this with one hand remove the wood with the other by peeling off the bark. The fibre is next separated from the bark by scraping—*retting or steaming greatly injures the fibre.** The yield of fibre to weight of stems is by one writer said to be only 1·56 per cent. This is undoubtedly one of the greatest obstacles to a large industry, but when it is recollected how extensive an area of waste ground might be thrown under the plant, that large tracts are even now relegated to this plant in a wild state, and when to these considerations is added the great value of the fibre, due to its adaptability as a silk substitute and to other purposes for which a high price can be realized, the question of its possible future, from a commercial point of view, is hardly matter for doubt. Past experiments in India would seem to point to the conclusion that in spite of the recognised merit of the fibre it is doubtfully possible to raise the plant to a commercial position. But such an opinion

First step to be taken.

Amount required.

A point of importance to be determined.

Method of separating the fibre-bundles.

* Note.—It is probable a chemical process of extracting the bark-fibre would succeed better than a mechanical. See the remarke under Rhea No. 18.

10. is opposed to the verdict pronounced at the late Colonial and Indian Exhibition. Hence the present recommendation that large samples should be collected both with the view to enable the merchant at home to test the fibre, and from his report to furnish the people of India with as much as can be learned about the qualities most worthy of cultivation, the season of cutting, and the method of separating and cleaning the fibre for the European market. If possible, therefore, in collecting the samples recommended, care should be taken to note the age of the twigs employed, and to record any facts known to the people of India regarding the merits of certain recognizable forms or the advantages claimed for different modes of preparation. Any observations recorded regarding the preparation of the crude fibre should be carefully preserved, such as the advantage of drying the twigs or otherwise before peeling off the bark, and the superiority ascertained of methods of beating or scraping the bark.

Collections might be made by Bengal, Burma, N.-W. P.

NOTE.—A maund of fibre from the stems should be procured from each of the following localities (gathered from wild stock of best recognised quality), *viz.*, Calcutta, Lucknow and Burma. To compare with this wild supply a maund, if possible, from the cultivated plant from Chutia Nagpúr and another from Saharanpur should be added. It may not be possible to prepare in its final state so large a quantity of fibre, and in that case the dried bark would suffice, since it could be cleaned in Europe. Two seers of the bark-yielding twigs should be collected and dried with their barks intact at each of the localities mentioned above, and during the following stages of growth :—

(*a*) Saplings before flowering.
(*b*) When in flower.
(*c*) When in fruit.

The barks on these twigs would be subjected in Europe to a thorough examination in order to discover the best period for cutting. The twigs for this purpose should be cut off as long as possible from their origin on the perennial stem to the extreme tip (entire), the leaves being stripped off when the twigs are dry so as in no way to tear the bark. The twigs should be dried in the shade, and when perfectly dry, tied up, each bundle bearing a ticket giving full particulars as to the locality, date when cut, stage of growth (*a*, *b*, *c*), and method of drying. Reference should be also recorded to the correspondingly prepared fibres and dried twigs.

For **Calotropis Floss** see No. 19 SILK COTTONS.

11.—Caryota urens, *Linn.; Gamble, Man. Timb., 420;* PALMÆ. *Dictionary, Econ. Prod., India, II., 207.*

THE KITTUL FIBRE.—KNOWN IN BOMBAY AS THE HILL PALM; also "SAGO PALM."

Amount required.

An effort seems desirable to start a trade in Indian *kittul* fibre. For this purpose it would appear to be the better course to address the authorities of Bombay (Kolaba district), of Burma, and of Orissa, regions where the palm is reported to abound. The appended extract from the Dictionary will be found to give the necessary particulars regarding the fibre, and it would perhaps be desirable to obtain one maund of the fibre from each region. In furnishing the samples, however, information should at the same time be collected as to the probable amount annually available, and the price at which it could be supplied.

Collections might be made by Bombay, C. P., Bengal, and Burma, and probably through the Forest Department.

NOTE.—The fibre might be procured from Bombay, Chanda, Orissa, Darjeeling, and Burma. Amount required one maund from each region, but the fibre from the leaves and leaf sheath should be separately registered from that obtained from the stem.

Vern.—*Mari*, HIND.; *Rungbong, simong*, LEPCHA; *Bara flawar*, ASS.; *Salopa*, URIYA; *Mari-ká-jhár*, DEC.; *Bherawa, berli, bhirli mahad, berli mád, bherlá máda, berli mhár, ardhi supári*, MAR.; *Birli-mhad, birli*

II.

mhar, BOMB.; *Shiwajatá, shaukar jata*, GUJ.; *Birlimád*, KONKAN; *Mhár mardi, mari, jirúgú, goragú, gorregu*, TEL.; *Conda-panna, erim-pana, utalipanna, kúndal-panai*, TAM.; *Bhyni, beina, bagni, baini*, KAN.; *Shunda pana*, MAL.; *Kittúl, nepora*, SING.; *Hlyamban*, MAGH.; *Minbo, minbaw, kimbo*, BURM.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 668; Brandis, For. Fl., 550; Kurs, For. Fl. Burm., II., 530; Voigt, Hort. Sub. Cal., 637; Kurs, Enum. Burm. Palms; Thwaites, En. Ceylon Pl., 329; Dals. & Gibs., Bomb. Fl., 278; Pharm. Ind., 248; Moodeen Sheriff, Supp. Pharm. Ind., 92; Ainslie, Mat. Ind., I., 452; S. Arjun, Bomb. Drugs, 147; Lisboa, U. Pl. of Bomb., 135, 212, 237; Spons, Encyclop., 938, 1827, 1904; Balfour, Cyclop.; Smith, Dic., 307, 362; Royle, Fib. Pl., 98; Treasury of Botany; Journ. Soc. of Arts, XXXII., 734; Mason's Burma, 811; Bomb. Gas., XI., 30; XIII., 21; XIV., 252; Settlement Reports, C. P., Upper Godavery, 39, Chanda, 108; Special number of the Madras Selections dealing with Fibres.*

Habitat.—A beautiful palm, with smooth, annulated stem, met with in the forests of the western and eastern moist zones. On the Western Ghâts, it extends to near Mahableshwar. In the Settlement Reports of the Chanda district it is stated that this palm abounds in the south-eastern corner of Aheree, and might with advantage be extended to all parts of the district, for it thrives well wherever it is planted. It is common in Burma, Bengal, and Orissa, ascending in Sikkim to 5,000 feet.

FIBRE.

Fibre.—"The leaves give the *Kittul Fibre*, which is very strong and is made into ropes, brushes, brooms, baskets, and other articles; the fibre from the sheathing petiole is made into ropes and fishing-lines" (*Gamble*), and is said to be suitable for paper manufacture.

USES. Brushes, Corsets. Ropes.

At the Colonial and Indian Exhibition (1886-87) much interest was taken in *salopa* fibre sent from Orissa, Burma, and Kolaba in Bombay. A corset manufacturer applied at the office of the Indian section for a fibre which might take the place of whale-bone in corset-making. He was shown the *salopa* (*kittul*) fibre and also the similar cord-like fibres from the interior of the stems of the cocoa-nut, palmyra palms and talipot palm (**Corypha umbraculifera**). It was suggested that if either of these were to be sewn in bands into the fabric of the corset the desired object would be obtained. The idea met with approval, and within a few days the manufacturer exhibited a sample and expressed the utmost confidence that if he could procure a continuous supply of the fibre a large trade might be done. He was referred to the Commissioner for the Ceylon Court since a considerable trade was being done with that Colony in its *kittul* fibre. Shortly after, however, he returned with the report that while the *kittul* fibre was perhaps preferable for the brush-maker, the softer nature of the *salopa* fibre of India made it more desirable for his purpose. These facts are alluded to in the hope of awakening interest in an Indian fibre that has been much neglected. For a good few years past Ceylon has done a by no means inconsiderable trade in *kittul* fibre, but no person seems to have thought of India as a possible source of supply. Since its introduction into commerce in 1860, the uses of *kittul* have greatly extended, and there would, therefore, seem everything to justify the expectation that India might with advantage enter into competition with Ceylon. The *kittul*, or as it is called in Orissa the *salopa* fibre, is the cord-like fibro-vascular bundles which surround the base of the leaf-sheath. **Mr. A. Robottom** was the first to introduce *kittul* fibre to European commerce: that gentleman is reported in *Spons' Encyclopœdia* to have stated that Indian *kittul* is inferior to Ceylon. At the Colonial and Indian Exhibition he pointed out to the writer a sample of the much inferior *kittul*-like fibre from **Arenga sacchari-fera** (see **A. 1336**) as the *kittul* he had formerly seen as sent from India. He admitted that the sample of *salopa* shown him at the Exhibition was as good as any he had ever seen from Ceylon, and seemed confident a large trade could be done in the Indian fibre.

Trade in the Fibre.

II. Leaf stalk. Tomentum. Stem Fibres.

It is commonly reported that in Ceylon the black fibre from the leaf-stalks is manufactured into ropes which are of great strength and durability, being used for tying up wild elephants. A woolly material found at the base of the leaves is sometimes used for caulking ships in Burma. In some parts of India the cord-like fibre from the stem of this and other palms is employed as a bow-string or as a fishing line (see B., 667) (*Royle, Fib. Pl.*).

MEDICINE.

Medicine.—"An excellent spirit is obtained by the fermentation and distillation of the toddy obtained from this elegant palm, which is not uncommon on the west coast of the Madras peninsula. It is well adapted for pharmaceutical purposes." "A glass of the freshly-drawn toddy, taken early in the morning, acts as a laxative" (*Pharm. of India*). "The nut is used as an application to the head in cases of hemicrania, from an idea of the supposed efficiency of the half nut in curing the affected half of the head" (*S. Arjun, Bombay Drugs*).

FOOD.

Food.—Roxburgh writes: "This tree is highly valuable to the natives of the countries where it grows in plenty. It yields them, during the hot season, an immense quantity of toddy or palm wine. I have been informed that the best trees will yield at the rate of 100 pints in the 24 hours. The sap in some cases continues to flow for about a month. When fresh, the toddy is a pleasant drink, but it soon ferments and when distilled becomes arrack, the gin of India. The sugar called jaggery is obtained by boiling the toddy. The pith or farinaceous part of the trunk of old trees is said to be equal to the best sago; the natives make it into bread, and boil it into thick gruel; these form a great part of the diet of those people, and during the late famine (1830 ?), they suffered little while those trees lasted. I have reason to believe this substance to be highly nutritious. I have eaten the gruel, and think it fully as palatable as that made of the sago we get from the Malay countries." (*Fl. Ind.*)

"The trees are tapped when they are from fifteen to twenty-five years old. Besides bruising and binding it, the spathe, which is called *kote*, is heated to make the juice flow. Every three or four days a white cottony substance, called *kaph*, which forms in the centre of the spathe, is removed. The stem of the tree is so soft that notches cannot be cut, and the tapper climbs by the help of branches tied to the trunk. Tapping goes on for eight months in the year. It is stopped during the rainy season (June to October), because the tree becomes slippery and the spathe cannot be heated. The trees are not allowed to rest, but are tapped until they are exhausted. In good ground they last for ten years, and in poor soil for four or five. After this they are useless. In yield, or in the value of the juice, the big-trunked palm differs little from the palmyra. Since 1879, when the tree-tax was raised from 1*s.* 6*d.* to 6*s.* (*annas 12 to R3*), the number of trees tapped has greatly fallen" (*Bomb. Gaz.* (Kolaba), *XI., p. 30*).

TIMBER.

Structure of the Wood.—The outer part of the stem is hard and durable, and the vascular bundles crowded, black, very large. The wood is strong and durable; it is used for agricultural purposes, water conduits, and buckets. It is "useful for building purposes" (*Thwaites*). "Is in general use for field-tools" (*Bomb. Gaz., XV., I., 65*).

Caryota sobolifera, *Wall.; Kurz, Enum. Burm. Palms in Journ. As. Soc., 1874, p. 203.*

The properties of this tree are probably identical with the above.

GEORGE WATT,

SIMLA, *Reporter on Economic Products.*

November 20th, 1888.

VOL. I.; PART II. (No. 14); of 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

A Note on the Cocoa-nut fibres.

12. COCOS NUCIFERA, *Linn.*

The following abstract from the *Dictionary of Economic Products* will be found to contain the main facts regarding the fibres obtained from **Cocos nucifera.** In the writer's opinion, the growth of the Indian trade in Coir, or the fibre from the husk of the nut, has been retarded through misapprehensions regarding the source of the better class qualities of that fibre. At most Exhibitions samples of Bengal Coir have been shown: and undue prominence thus given to an inferior article, while Malabar Coir has, to a large extent, been overlooked. It would, therefore, seem desirable to have typical collections prepared of the coir fibres of certain localities with the view of placing these in Museums. A reference to the remarks below under the headings "Peculiarities of Cultivation in India," and "Trade in Indian Coir," will be found to indicate the chief regions where the palm is grown. Information seems desirable as to whether special trees are grown for *kopra* (oil), and others for the fibre. Accepting as correct the general conclusions which the writer has arrived at, the following are the districts or regions from which it would seem advisable to obtain collections of coir fibre:—

Collections should be made from the—

1st—The Laccadive Islands.

2nd—The Mainland of the Malabar District.

Laccadive Islands; Malabar Mainland

There need be no difficulty in procuring the coir from the first-named locality, as it is said to arrive on the mainland in March and April, and to be stored in Government godowns. Kiltan Coir is regarded as the best.

It may be here remarked that the Laccadive Islands are, for administrative purposes, treated as part of the Malabar district, and, consequently, the coir from these Islands appears to be returned as Malabar Coir. It seems probable, however, that the Laccadive Coir may be quite different from that of the mainland, if, indeed, it be not obtained from a distinct and specially cultivated form of the palm. To clear this matter up, therefore, it is deemed expedient to have separate collections of coir made from the Laccadive Islands, and from the Malabar mainland.

3rd—Cochin.

Cochin;

It will be found that the account given below of Cocoa-nut fibre some care has been taken to bring out the chief facts regarding the coir from the

12 Native State of Cochin. According to commercial reports the first place is given to "Cochin Coir." It would, therefore, seem desirable that collections should be procured from that locality.

Travancore: *4th*—The Native State of Travancore.

Manufactured coir is largely exported from this State, but little is known in European commerce of the special properties of Travancore Coir.

Madras Presidency *5th*—Madras Presidency generally.

All along the coast of Madras admirable coir is obtained; and, to contrast with the collections suggested above, it might be desirable to have samples from more southern and also northern positions than named; *e.g.*, from the Coromandel Coast.

Mysore: Nicobar Islands: *6th*—Mysore.

7th—The Nicobar Islands.

The opinion has been advanced that there is some hope of a possible large trade from these islands. It would, therefore, seem desirable either to have samples or to ascertain if the nuts from these islands are or are not serviceable for that purpose.

Bombay. *8th*—Bombay.

The palm is grown to some extent in the coast tracts of Bombay, but little or nothing is known as to the extent of coir manufacture or the quality of the fibre.

In furnishing samples of the coirs named above, it would be most desirable to have two or three entire nuts sent with each sample, as also other nuts, &c., showing the stages of separation and purification of the coir. To clear up the doubts which exist regarding the cocoa-nut palms, answers to the following questions would be most useful. By expressing the difficult points in the definite form of questions it is hoped the minimum amount of trouble may be occasioned.

Difficult Points.

1st—Is the palm grown expressly for its coir; in other words, are the ripe nuts from the same tree collected for the purpose of affording *copra*?

2nd—Are the trees tapped for their toddy; and, if so, does the tapping improve the yield of nuts, or injure the quality of the oil or of the fibre?

There would seem to be certain cultivated forms of cocoa-nut that are famed for their good fibre, and others for their oil. The above questions are aimed at elucidating this point—namely, does one individual tree yield fibre, oil, and toddy, or are separate trees grown for these products?

(Conf. with p. 213.)

3rd—If the trees are tapped, is it obligatory on the cultivator to pay a tax on each tree so tapped, even when the juice is employed in the preparation of sugar, and not for the purpose of fermentation?

4th—The act of tapping destroys, of course, the spikes from which the juice is drawn, but as all the spikes (spathes) on a tree do not appear to be tapped, do the others continue to ripen their nuts? In other words, does a tapped tree yield in addition to toddy both coir and copra? Is more than one spike tapped at one time on the same tree?

5th—How many nuts are required to yield a maund of dry copra? In some districts copra is largely prepared, and if the answer to this question was known, it would (from the returns of the trade in copra) be possible to arrive at a more correct knowledge of the actual yield of nuts in India. For example, some confusion exists as to the total production in

the Nicobar Islands owing to our not being able to ascertain how many nuts represent the thousands of maunds of copra annually exported from these Islands. 12

NOTE.—Of each sample of coir half a maund would suffice for the collections it is presently desired to prepare; but each such sample should be accompanied with nuts in all stages of preparation, *viz.*, entire, cut open, showing the first process of removal of the husk, dry husk, first and second and final stages of cleaning the fibre, &c., &c. Articles made of coir, especially trade samples of commercial manufactures, would be highly desirable for the Imperial Institute Collection. All samples, whether raw or manufactured, should be accompanied with a note giving the nearest possible approximation to wholesale prices, quantity available, and the names of merchants, growers, or manufacturers who would be willing to open up dealings with merchants in England who might desire to do so seeing their samples. **Quantity required.**

(Conf. with p. 213.)

COCOS, *Linn.; Gen. Pl., III., 945.*

Cocos nucifera, *Linn.; Brandis, For. Fl., 556;* PALMÆ.

THE COCOA-NUT PALM; THE COIR OR COCOA-NUT FIBRE; PORCUPINE WOOD; COCOSER, *Fr.;* COCOSNUSS, KAIR, *Germ.*

Vern.—*Nárel, náriyal, náriel, náriyel, náriyal-ka-pér,* HIND.; *Nárikel, náriyal, dáb, nárakel,* BENG.; *Nariel, nariyéla, náriera, náliyer, náryal, jháda, náryal,* GUJ.; *Maar, naril, mahad, narel, naral-cha-jhádá, már, naural,* BOMB.; *Narela, nárula, náralmád, mád, máda, mahad, várala, narel, nárali-cha-jháda, naral, mar, tenginmar* (the juice-yielding form in Kanara), MAR.; *Nárél-ká jhár, nárél,* DUK.; *Tenna, tenga, tennan-chedi, tenna-maram, téngáy, taynga,* TAM.; *Nari kadam, tenkáia, kobbari, goburri-koya, ten kaya, kobri chullú, kobbari-chettu, tenkáya-chettu, erra-bondala, gujju-narekadam,* TEL.; *Thenpinna, kinghenna, tengina, tenginá-gidá, tenginá-káyi, tengina-chippu, tenginay amne, tenginararu,* KAN.; *Tenga, ténn-maram, tenna, nur, kalapa, nyor, kalambir,* MALA.; *Nur,* MYSORE; *Nári-kela, nári-kera, nári-keli, langalin,* SANS.; *Jadhirdah, shajratun-nárjil, shajratul-jouse-hindi, nárjil, jouse-hindi,* ARAB.; *Darakhte-nárgil, darakhte-bándinj, nárgil, badinj* (*narjible* in Ainslie), PERS.; *Pol, pol-gass, pol-gahá, pol-nawasi, tambili,* SING.; *Ong, ung, ung-bin, ón, onsi, onti, ondi,* BURM.; *Kalapa,* JAVA.

DRY KERNEL, COPRA (KOPRA) OR COPPERAH—
Khóprá, HIND.; *Khópru,* GUJ.; *Khóprá, khópré-ki-batti,* DUK.; *Kobbarait-téngáy,* TAM.; *Kobbera, kobbera-ténkáya,* TEL.; *Kóppara,* MALA.; *Kobari, kobbari,* KAN.

OIL, COCOA-NUT OIL—
Khópáre-ká-tél, nariyal-ká-tél, naril-ká-tél, HIND., DUK.; *Nárikél-tail, náriyal-tél,* BENG.; *Náryal-nu-tél,* GUJ.; *Náralicha-téla, naral-tela, kóbra cha-téla,* MAR.; *Téngá-yenney, taynga-nunay, tengái-yenne,* TAM.; *Tenkáya-núne, tenkáia núnay,* TEL.; *Ténna-enna, minak, kalapa, minak-nur, nur-minak, kalambir, kalapa minak,* MALA.; *Tenginá-yanne, cobri,* KAN.; *Nárikela-tailam,* SANS.; *Dhonun-narjil, dhonul-jouse-hindi* (*jows-hind* in Ainslie), ARAB.; *Róghane-nárgil, róghane-bándinj,* PERS.; *Pol-tel,* SING.; *Ón-si,* BURM.; *Cay-dua,* COCHIN-CHINESE.

WATER—
Yelnir-ka-pani, DUK.; *Yella nir,* TAM.; *Yella-niru,* TEL.

TODDY—
Nárélí, HIND.; *Nárél-ki-séndi, narillie,* DUK.; *Téngá-kallu, tennan-kallu, tennang-kallú,* TAM.; *Tenkáya-kallu, tenkala,* TEL.; *Nargilie, nargilli,* ARAB.; *Táriye-nárgil,* PERS.

FIBRE—
Coir ? (See first paragraph of chapter on Coir), HIND.; *Tennam nar,* TAM.; *Tenkaia nar,* TEL.

COCOA-NUT CABBAGE—
Tennam kurtu, TAM.; *Tenkaia gurtu,* TEL.; *Naril-ka-krute,* ARAB.

COTTON OR TOMENTUM—
Tenna maruttú pungie, TAM.; *Tenkeia-chettú-puthie,* TEL.; *Tennam-púppa,* MAL.

Habitat.—A pinnate-leaved palm, with a straight or often gracefully curved stem, marked by annular scars; cultivated throughout tropical

12 India and Burma, especially near the sea-coast. On the eastern and western coasts it is particularly abundant, more so towards the south. There are several cultivated varieties but all flower in the hot season, the nuts ripening from September to November. **Dr. Shortt** states that in South India the palm thrives at altitudes up to 3,000 feet above the sea, and he even mentions one on the Shevaroy Hills at 4,500 feet. Cocoa-nuts are abundant in Bangalore up to 3,000 feet.

Indian Region. Starting from the Bay of Bengal, the cocoa-nut palm follows the Gangetic basin inland for about 150 to 200 miles; from the western coast its cultivated distribution inland is much more limited, and in Kolaba, for example, is little more than half a mile from the beach. In very exceptional circumstances, or under the most careful garden cultivation, it may be seen further inland in Bengal than stated, and it even occurs in some parts of Assam. It is, however, essentially a plant of the coast, and luxuriates on the islands of the Indian Ocean. The Indian region of the cocoa-nut may thus be said to be the lower basins of the Ganges and the Brahmaputra, and the Malabar and Coromandel coasts. In the Brahmaputra valley it ascends to a greater distance from the sea than in the Gangetic; but in both it is an introduced tree, as it nowhere occurs in forests far away from human dwellings. On the Malabar coast, and on the islands off the coast of India, it may be different; but even in these localities it rarely exists as a forest tree, although it is self-sown. It is abundant on the Laccadive Islands, and on the Nicobar group in the Bay of Bengal, but excepting the recent efforts at cultivation, it was formerly rarely met with on the Andaman Islands, which are only 72 miles to the north. It re-appears again, however, abundantly on the Cocos Islands, a small group lying some 30 to 40 miles still further north (where it is in no way cultivated). **M. DeCandolle** states briefly the arguments in favour of an American as well as those of an Asiatic origin for this tree, and concludes by expressing the opinion that it most probably belongs to the "Indian Archipelago." Its introduction into Ceylon, India, and China, he states, does not date further back than three thousand years, "but the transport by sea to the coasts of America and Africa took place perhaps in a more remote epoch, although posterior to those epochs when the geographical and physical conditions were different from those of our day."

CULTIVATION OF THE COCOA-NUT.

CULTIVATION. It is commonly reported that there are in India 489,000 acres under the cocoa-nut. A number of passages from Indian authors will be found scattered through the present account of the palm, which every now and again recur to the question of its cultivation. It may, however, be desirable to give here a brief abstract of the opinions published by the better known European writers, since from these may be gathered the results of scientific experiments.

Sowing. SOWING.—Ripe nuts, carefully collected, should alone be employed as seed, and for this purpose they are usually gathered from February to May. Seed from very young or very old trees should be avoided. After having been kept for a month to six weeks they should be planted. This may take place in January to April, or again in August, provided the rains are not heavy. The seed-beds should be dug 2 feet deep and the nuts planted 1 foot apart. The nuts should be laid on their sides, leaving 2 inches of their surface exposed. Ashes, or ashes and salt, should be freely placed in the trenches; these act both as a manure and as a preventative against insects. The seed-bed thus prepared should be kept moist, but not soaked. The germinated seeds may be transplanted when they are in their second to their sixth or even twelfth month. In the Godavari district they are placed in their permanent positions when three to four

years old. In damp localities the transplanting may be done in the hot season, otherwise during the rains.

12 CULTIVATION.

Transplanting.

TRANSPLANTING.—The seedlings should now be put out in the plantation, pits 12 yards apart having been prepared for them. In rich soils the pits may be small, but in poor soils 1 to 2 yards wide and 2 or 3 feet deep. In cold clay soils these pits should be filled with sand. In marshy land, walls should be constructed around them. Ashes are often recommended to be freely mixed with the prepared soil to be put into the pits, as this is supposed to prevent the attacks of the beetles that prove so destructive to the trees. Cultivation of turmeric, arrowroot, &c., in the pits, along with the cocoa-nuts is believed to be beneficial. The soil round the seedlings is also often kept damp by a bed of leaves, particularly such as will not encourage, but rather check, the approach of ants into the prepared soil. If the soil be naturally poor, salt, ashes, paddy-straw, fish manure, goats' dung, and dry manures may be added during the first year.

Treatment of Plantation.

TREATMENT OF PLANTATION.—By the end of the first year the normal leaves will begin to form, and at this stage the soil around the plants should be dressed and ashes added. Every succeeding year the ground should be opened out and manured about the commencement of the rains, the soil being replaced and levelled about the close of the rains. By the fourth year the stem begins to appear and has about 12 leaves; it is distinctly visible by the fifth year, when the tree has about 24 leaves. The spathes commence to be formed by the sixth year, and the stem is then 1 to 2 feet above the ground, but in exceptionally favourable climates and soils it may be three or four times that height. The first few spathes do not form fruits, but bye-and-bye they begin to do so, and in three or four more years the tree is in full bearing. **Dr. Shortt** says that in good soils and if watered the cocoa-nut begins to yield in the fifth year, but in poor soils and if not watered they only commence to yield in the seventh or not till the tenth year. About six months after flowering the fruits set, and by the end of the year they are fully ripe.

Cocoa-nut palms may be easily transplanted, and indeed often with advantage. Some of the fibrous roots should be cut away, and manure, together with a little salt, placed in the pit in which it is intended to plant the tree.

Yield.

YIELD.—As a rule a cocoa-nut throws out a spathe and a leaf every month: each flowering spike yields from 10 to 25 nuts. The produce of a tree in full health and properly tended may be from 50 to 120 and even 200 nuts a year, the yield depending greatly, of course, on the suitability of the climate and soil for cocoa-nut cultivation; a safe average would be 100 nuts a year to each tree in full bearing. The cocoa-nut will continue to bear for 70 to 80 years.

CULTIVATED FORMS.

There are five recognisable varieties of the cocoa-nut met with in Ceylon. These have been described as, *1st*, the *Tembili*, a plant with an oval-shaped nut of a bright orange colour; *2nd*, a more spherical form; *3rd*, a heart-shaped fruit of a pale yellow colour, with an edible inner rind, which turns red when the outer skin is removed; *4th*, the ordinary form; *5th*, a small nut about the size of a turkey's egg. This last form is rare but much admired. **Spon** (*Encycl.*, 1353) says "there are some 30 varieties of cocoa-nut distinguished by the natives of the districts producing them, but many of these distinctions are obviously groundless." Repeated reference will be found throughout this article to the different forms which occur in India, but of these, with perhaps the exception of that met with in the Laccadives, scarcely any deserve special mention. The Laccadive small-fruited form, with a soft, fine, but strong coir, seems well worthy of special consideration where the object of cultivation is the production of fibre.

12 CULTIVATION.

Dwarf Cocoanut.

Dr. **Shortt** says there are 30 different forms in Travancore. He adds: "The largest variety of cocoa-nut that I have seen and examined comes from Ceylon. I have occasionally seen specimens nearly as large from the Coromandel coast. There is a small dwarf variety which fruits while it is about 2 feet high; the plant continues to grow and with age attains to a height of from 10 to 15 feet." A small form is met with in East Africa that does not possess the fibrous pericarp. In Indian newspapers announcements of branched cocoa-nuts occasionally appear, as also of branched date-palms. These are viewed with superstitious horror by the ignorant. They are most probably the result of two plants growing together, or of two or more embryos in one nut.

Soil.

Soil.—The cocoa-nut "thrives best in low, sandy situations, within the influence of the sea breeze, and never attains the same perfection when grown inland." (*Spons' Encycl.*) **Simmonds** writes: "Soils suitable for a cocoa-nut plantation are variously described as below, particularly observing that stony grounds, or those overlying rocky foundations, are to be avoided:—

"(1) Soils mixed with sand, either dark-coloured or river-washed.
"(2) Where sand is mixed with clay, ferruginous earth, or black mould.
"(3) Clayey soils where the under-strata consist of sand.
"(4) Sand and clay, even when mixed with gravel and pebbles.
"(5) The sea-shore banks of backwaters, rivers, tanks, and paddy-fields.
"(6) Alluvium of rivers and backwaters, provided a yard and a half of land is to be generally seen above water-level.
"(7) Marshy land even in brackish soils (but not where salt is formed in crystals by evaporation).
"(8) All level lands exposed to the sea breeze where the soil is good, as the valleys between hills, tanks, and ditches which have been filled up.
"(9) Lastly, even the floors of ruined houses well worked up, and any places much frequented by cattle and human beings on account of the ashes and salts of ammonia from the urine, &c., deposited day by day in the soil."

Simmonds further says: "The nuts for seed should not, on being gathered, be allowed to fall to the earth, but be lowered in a basket or fastened to a rope. If let fall, the polished cover to the fibres will be injured and collect damp about the nut, or the shell inside may be cracked and the water disturbed. These are fatal injuries, or even if the plants still grow, they will, on being transplanted, not make fresh shoots, but produce weak trees having their fronds constantly drying up, nuts rarely matured, and often are even without kernel in those which appear perfect. If the nuts are allowed to dry on the tree before gathering, the plants are liable to be lost, not having water inside to cherish the growth of the sprout (before the actual roots shoot into the soil)."

"Nurseries should be somewhat exposed to the influence of the sun, though not too much heat: plants thus grown will even, though deficient in stature, be strong, and when transplanted will not fail, nor suffer from heat. The planting of the nuts should take place in January to April, and also in August, provided the rains are not heavy, and then the planter may expect fruitful trees to be produced when grown; but nurseries formed during the heavy monsoon will generally fail, or produce trees which will yield small nuts. Too much moisture of every kind is injurious to the plants." Speaking of soils **Dr. Shortt** says: "The cocoa-nut requires alluvial and loamy soil for its successful growth, but any soil with a free mixture of sand and clay answers fairly well. Sea-sand where procurable is recommended to be thrown into the pits when the earth is being returned around the plants. Half sand half earth is considered the best material to fill up the pits with."

Peculiarities of Indian Cultivation.

12 CULTIVATION.

I. Bombay.

The following passages from the Gazetteers will be found instructive and of value to intending cultivators as having a special bearing on India.

I. *In Bombay* (*Kolaba District*).—Of the liquor-yielding trees of this district the cocoa-palm is the most important. "The moist climate, sandy soil, brackish water, and abundance of fish manure, make its growth so vigorous that the yield of juice is much in excess of the wants of the district. The trees are grown within walled-in or hedged enclosures, sometimes entirely given to cocoa-nut palms, in other cases partly planted with mangoes, jack, betel-nut, and other fruit trees. Every garden has one or two wells, from which the trees are watered by a Persian wheel. In starting a cocoa-nut garden, a bed is prepared, and in it, at the beginning of the rainy season, from twenty to forty large, ripe, unhusked nuts are planted 2 feet deep. The bed is kept soaked with water, and after from three to six months the nut begins to sprout. The seedlings are left undisturbed for two years. They are then, at the beginning of the rains, planted in sandy soil in rows about 18 feet apart, and with a distance of about 15 feet between the plants. For about a foot and a half round each plant the ground is hollowed 3 or 4 inches deep, and during the dry months the plants are watered daily or once in two days, and, once or twice in the year, enriched with fish manure or with a mixture of salt and *náchni*. When nine years old the trees begin to yield nuts twice a year and sometimes thrice, 120 nuts being the yearly average yield from each tree. The trees are then ready to be tapped. Each cocoa-palm, when ready for tapping, is estimated to represent an average outlay of about 18*s*. (R9).

"The cocoa-nut gardens are generally owned by high-caste Hindus, who let the trees to some rich Bhandári who has agreed to supply the owner of the liquor-shops with fermented or distilled juice. The Bhandári pays the owner of the garden R1 (2 shillings) a month for every three trees" (*Kolaba Dist., Bomb. Gas., XI., 28*). Of the Thana District it is stated—"The seed-nuts are prepared in different ways. The best and oldest tree in the garden is set apart for growing seed-nuts. The nuts take from seven to twelve months to dry on the tree. When dry they are taken down, generally in April or May, or left to drop. When taken down they are either kept in the house for two to three months to let half of the water in the nut dry, or, if the fibrous outer shell is not dry, they are laid on the house-roof or tied to a tree to dry. After the nuts are dry, they are sometimes thrown into a well and left there for three months, when they sprout. If the nuts are left to drop from the tree, which is the usual practice in Bassein, they are either kept in the house for some time and then left to sprout in a well, or they are buried immediately after they have fallen. When the nuts are ready for planting they are buried either entirely or from one half to two thirds in sweet land, generally from 1 to 2 feet apart, and sometimes as close as 9 inches. A little grass, rice-straw, or dry plantain leaves are spread over the nuts to shade them. If white-ants get at the nuts the grass is taken away, and some salt or saltish mud mixed with wood ashes and a second layer of earth is laid over the nuts. Nuts are sometimes planted as late as August (*Shrávan*), but the regular season is from March to May (*Chaitra* and *Vaishákh*), when, unless the ground is damp and their inner moisture is enough for their nourishment, the nuts want watering every second or third day until rain falls. The nuts begin to sprout from four to six months after they are planted, and when the seedlings are a year or eighteen months, or, what is better, two years old, they are fit for planting. At Bassein the price of seedlings varies from 5*d*. (3 annas 4 pie) for a one or one and a half year old seedling, to 6*d*. (4 annas) for a two-year-old plant. In planting them out the seedlings are set about six yards (12 *háts*) apart in the 2-feet-deep holes, in which

12 CULTIVATION.

about 1¼ pounds (2 *tipris*) of wood-ashes have been laid to keep off white-ants, and the garden must be very carefully fenced to keep off cattle. The plants are then watered every second day, if not every day, for the first year; every third day, if not every second day, for the second and third year; and every third day, if possible, for the fourth and fifth year. Watering is then generally stopped, though some Bassein gardeners go on watering grown trees every seventh or eighth day. For two years after they are planted out the young trees are shaded by palm leaves or by growing *mutheli* plantains. During the rains, from its fifth to its tenth year, a ditch is dug round the palm and its roots cut, and little sandbanks are raised round the tree to keep the rain-water from running off. In the ditch round the tree, 22 pounds (4 *páylis*) of powdered dry fish manure (*kuta*) is sprinkled and covered with earth, and watered if there is no rain at the time. Besides fish manure the palms get salt-mud (*khára chikhal*) covered with the leaves of the croton-oil plant, *jepál erand* (**Croton Tiglium**), and after five or six days with a layer of earth; or they get a mixture of cow-dung and wood-ashes covered with earth; or night-soil, which on the whole is the best manure. Palms suffer from an insect named *bhonga* which gnaws the roots of the tree, and from the large black carpenter-bee which bores the spikes of its half-opened leaves. When a palm is suffering from the attacks of the *bhonga*, a dark red juice oozes from the trunk. When this is noticed, a hole 3 inches square is cut in the trunk from 4 to 6 feet above where the juice is coming out, and is filled with salt, which drives away or kills the insect. To get rid of the boring bee, it is either drawn out by the hand, or it is killed by pouring into the spike assafœtida water or salt-water.

"A well-watered and manured tree, in good soil, begins to yield when it is five years old, and in bad soil when it is eight or ten years old. A palm varies in height from 50 to 100 feet, and is in greatest vigour between the ages of twenty and forty. It continues to yield till it is eighty, and lives to be a hundred.

"When the tree begins to yield, a sprout comes out called *poi* or *pogi*, at the bottom of which is a strong web-like substance called *pisundri*. After about a fortnight the tree flowers, though few blossoms come to perfection. Many of the young nuts also fall off, and only a few reach maturity. A young nut is called *bonda*, a nut with a newly-formed kernel is called *shále*, and a fully-formed nut *nárel*. A good tree yields three or four times a year, the average number of nuts being about seventy-five" (*Gas., XIII., I., 295*).

In the report of the Káthiawár District (*Bomb. Gas., VIII., p. 95*), there occurs a short but interesting account of the cocoa-nut: "At Mahuva, in 1875, 1,500 acres were planted with 170,000 palms. At Khandera there is a garden with 7,000 palms, and there are about 2,000 at Bhávnagar. The advantage of the cocoa-nut over the mango is the uniformity with which it bears." "A singular fact about the cocoa-palm is that it grows freely in solid limestone, provided a hole about 3½ feet deep by 3 feet in diameter is cut in the rock and filled with mould. All the trees at Gopnáth are planted in solid rock."

In concluding this account of the cultivation of the cocoa-nut it may be stated that, according to the various district Gazetteers, there are from 30,000 to 40,000 acres under the palm, with about 100 trees to the acre. Kánara, Ratnágiri, and Káthiawár appear to be the districts where the largest number of trees occur. Of Ratnágiri it is stated that if grown for the fruits only, each tree gives a net yearly profit of 2*s.* 4½*d.* (R1-3).

II. Madras.

II. *In Madras.*—The cocoa-nut palm flourishes in this Presidency, frequenting the banks of estuaries and backwaters, and abounding on the sandy tracts near the sea, especially along the Malabar and Coromandel coasts. Although met with in the Bombay Presidency, it is only plentiful

12 CULTIVATION. Madras.

in the southern division, and barely leaves the immediate coast. On nearing the Madras Presidency from Bombay it becomes more and more plentiful. Of its abundance on the Malabar coast an opinion may be formed from the description of the town of Cannanore, the clumps of the cocoa-nuts being said "to be seen between the officers' houses, surrounding the cantonments in every direction, and extending in the distance as far as the eye can reach; the cantonment may be said to be embedded in a forest of these trees" (*Royle*). Of South Kánara, it has been estimated that there are 80,000 acres under the cocoa-nut. Indeed, the Malabar coast and the Laccadive and Maldive Islands are pre-eminently the seats of the Indian cocoa-nut industry. The enquirer after Indian cocoa-nuts, coir, or cocoa-nut oil, need practically concern himself with no other part of the country unless he add to these the Nicobar Islands. The last-mentioned islands furnish a very large number of cocoa-nuts, but apparently the islanders are ignorant of, or too indifferent to learn, the art of making coir or expressing the oil. So far this remark seems to be almost applicable to the Maldives also, a group of large islands under a Sultan, who is subordinate to the Governor of Ceylon, and not to the Viceroy of India. This fact is of some importance, since the casual examination of the trade returns might convey the idea that the Laccadives export no coir, if the still further error might not even be committed of supposing the Laccadives to contain no cocoa-nuts at all. The Laccadives are mainly under the administration of the Collector of Malabar, and the imports from these islands are treated as if they were the produce of the main land, while the imports from the Maldives are returned as from foreign territory. Last year the Maldives sent 7,897,453 cocoa-nuts to India, and the Nicobar Islands 4,510,000. Of the inhabitants of these groups of islands it is not reported that they manufacture coir, and apparently they prepare only a small amount of copra, although they sell their nuts at a price far below that which prevails on the mainland of India.

Writers in Europe, who have described the commercial article Coir, are in the habit of placing the coir from Cochin in the first rank. Some doubt seems to be associated, however, with the commercial term "Cochin Coir." The small Native State probably alluded to is described in the *Imperial Gazetteer* as "possessing no important trade by sea or land." It seems impossible to believe that all the coir returned under the name of "Cochin Coir" could therefore come from Cochin. Indeed, the suspicion exists that the better class of Malabar and Laccadive coir, consigned to Europe, may be so designated, if not also some of the exports of coir from Cochin-China and the Straits. In the returns of the coasting trade for British India it is shown that last year the total exports of coir from Cochin by sea amounted to only 689 cwt., valued at ₹4,134, and manufactured coir 2,777 cwt., valued at ₹25,339: these were all sent to Bengal or Bombay; how much may have gone by land to Madras cannot be discovered. It is significant that Dr. Shortt, in his Monograph on the cocoa-nut palm, which has just appeared, makes no mention of Cochin coir.

Repeated reference will have to be made, in subsequent pages, to the Laccadive and Malabar coir and the other cocoa-nut products from these regions, so that we shall here content ourselves with this brief notice of Madras, concluding only by giving the description of the cultivation given in *Morris's Descriptive and Historical Account of the Godavery District*: "Young plants of a year's growth are planted out, and watered for six years, after which they do not require much water. The trees generally bear fruit about the ninth year after transplantation. The expenses of cultivation are stated to be ₹668 for a *putti* of land,—namely, ₹140, being the price of 600 young plants, ₹48 being the value of the labour required for planting them, and ₹480 being the wages of labourers employed to water and tend the trees until they come into bearing. When the trees begin to bear fruit, the value of the produce of a tree, exclusive of the fibre,

12 CULTIVATION. III. Mysore.

is estimated at about 12 annas a year, making the total value of the produce in a *putti* of land R300" (*p. 70*).

III. *In Mysore* "there are four varieties of the cocoa-nut: *1st*, red; *2nd*, red mixed with green; *3rd*, light green; and *4th*, dark green. These varieties are permanent, but although the red is reckoned somewhat better than the others, they are commonly sold promiscuously. Their produce is nearly the same.

"The soil does not answer in the Bangalore district unless water can be had on digging into it to the depth of 3 or 4 cubits, and in such situations a light sandy soil is the best. The black clay, called *ere*, is the next best soil. The worst is the red clay, called *kebbe*; but with proper cultivation all the three soils answer tolerably well.

"The manner of forming a new cocoa-nut garden is as follows: The nuts intended for seed must be allowed to ripen until they fall from the tree, and must then be dried in the open air for a month without having the husk removed. A plot for a nursery is then dug to the depth of 2 feet, and the soil is allowed to dry three days. On the *Ugádi* feast (in March) remove 1 foot of earth from the nursery and cover the surface of the plot with 8 inches of sand. On this, place the nuts close to each other, with the end containing the eye uppermost. Cover them with 3 inches of sand and 2 of earth. If the supply of water be from a well, the plot must once a day be watered; but if a more copious supply can be had from a reservoir, one watering in the three days is sufficient. In three months the seedlings are fit for being transplanted. By this time the garden must have been enclosed, and hoed to the depth of 2 feet. Holes are then dug for the reception of the seedlings at 20 feet distance from each other in all directions, for when planted nearer they do not thrive. The holes are 2 feet deep and a cubit wide. At the bottom is put sand 7 inches deep, and on this is placed the nut with the young tree adhering to it. Sand is now put in until it rises 2 inches above the nut, and then the hole is filled with earth and a little dung. Every day for three years, except when it rains, the young tree must have water.

"The cocoa-nut palm begins to produce when seven or eight years old, and lives so long that its period of duration cannot readily be ascertained. Young trees, however, produce more fruit which comes forward at all seasons of the year. A good tree gives annually a hundred nuts. A few are cut green on account of the juice, which is used as drink, but by far the greater part are allowed to arrive at some degree of maturity, although not to full ripeness, for then the kernel would become useless.

"Cocoa-nut palms are planted in Chiknayakanhalli in rows round the areca-nut gardens, and also separately in spots that would not answer for the cultivation of this article. The situation for these gardens must be rather low, but it is not necessary that it should be under a reservoir; any place will answer in which water can be had by digging to the depth of two men's stature. The soil which is here reckoned most favourable for the cocoa-nut is a red clay mixed with sand. It must be free of lime and saline substances. Other soils, however, are employed, but black mould is reckoned very bad. The cocoa-nuts intended for seed are cut in the second month after the winter solstice. A square pit is then dug, which is sufficiently large to hold them, and is about a cubit in depth. In this, fifteen days after being cut, are placed the seed-nuts, with the eyes uppermost and contiguous to each other, and then earth is thrown in so as just to cover them, upon which is spread a little dung. In this bed, every second day for six months, the seed must be watered with a pot, and then the young palms are fit for being transplanted. Whenever, during the two months following the vernal equinox, an occasional shower gives an opportunity by softening the soil, the garden must be ploughed five times. All the next month it is allowed to rest. In the month following

12 CULTIVATION. Mysore.

the summer solstice, the ground must again be ploughed twice; and next month, at the distance of 48 cubits in every direction, there must be dug pits a cubit wide and as much deep. In the bottom of each a little dung is put; and the young plants, having been previously well watered to loosen the soil, are taken up and one is placed in each pit. The shell still adheres to the young palm, and the pit must be filled with earth so far as to cover the nut. Over this is put a little dung. For three months the young plants must be watered every other day; afterwards every fourth day, until they are four years old, except when there is rain. Afterwards they require no water.

"Every year the garden is cultivated for *ragi*, *uddu*, *hesaru*, or whatever other grain the soil is fitted for, and is well dunged, and at the same time four ox-loads of red mud are laid on the garden for every tree that it contains, while a little fresh earth is gathered up towards the roots of the palms. The crop of grain is but poor, and injures the palms; it is always taken, however, as, in order to keep down the weeds, the ground must at any rate be ploughed, as the manure must be given, and as no rent is paid for the grain. On this kind of ground the cocoa-nut palm begins to bear in twelve or thirteen years, and continues in perfection about sixty years. It dies altogether after bearing for about a hundred years. They are always allowed to die, and when they begin to decay a young one is planted near the old one to supply its place.

"In this country, wine is never extracted from this palm, for that operation destroys the fruit, and these when ripe are considered as the valuable part of the produce. A few green nuts are cut in the hot season, on account of the refreshing juice which they then contain, and to make coir rope; but this also is thought to injure the crop. The coir made from the ripe nuts is very bad, and their husks are commonly burned for fuel.

"The crop begins in the second month after the summer solstice, and continues four months. A bunch is known to be ripe when a nut falls down, and it is then cut. Each palm produces from three to six bunches, which ripen successively. A middling palm produces from 60 to 70 nuts. As the nuts are gathered they are collected in small huts, raised from the ground on posts. When a merchant offers, the rind is removed at his expense, by a man who fixes an iron rod in the ground, and forces its upper end, which is sharp, through the fibres, by which means the whole husk is speedily removed. He then, by a single blow with a crooked knife, breaks the shell without hurting the kernel, which is then fit for sale and is called *koppari*. A man can daily clean 1,300 nuts. From 20 to 30 per cent. of them are found rotten" (*Mysore Gaz., I., 131-134*).

IV. Nicobar Islands.

IV. *On the Nicobar Islands* the cocoa-nut palm is very abundant, although, as already stated, it exists only under recent cultivation on the Andaman Islands, but reappears still further to the north on the group of the Cocos Islands. **Sir W. W. Hunter** gives an interesting account of the Nicobar trade in cocoa-nuts which may be here quoted: "At present the principal product of these islands is the cocoa-nut palm, and its ripe nuts form the chief export." "The northern islands are said to yield annually 10 million cocoa-nuts, of which about half are exported. The estimated number exported in 1881-82 was 4,570,000. As this important product is six times cheaper here than on the coast of Bengal or in the Straits of Malacca, the number of English and Malay vessels that come to the Nicobars is every year increasing." "The trade in cocoa-nuts is carried on chiefly by native craft from Burma, the Straits Settlements, Ceylon, &c. Forty vessels of an aggregate tonnage of 6,270 tons visited the islands for cocoa-nuts in 1881-82." The Administration Report for 1885-86 gives the exports as 4,510,000 nuts and 5,730 bags of copra. In that year 49 vessels, with an aggregate tonnage of 8,218 tons, obtained permission to trade with the Nicobar Islands for cocoa-nuts, &c. The same

12 CULTIVATION.

report states that there are now 112,000 cocoa-nut palms under cultivation at Port Blair.

V. Burma.

V. *Of Burma* it is reported that the cocoa-nut is "largely cultivated, and might be much more so in many places along the Arakan coast as it is in Ceylon, and as doubtless it would be but for the sparseness of population, the difficulties of approaching the coast except at a few spots, and the absence of the means of land communication between the ports and the sites fitted for the production of the trees." In the Bassein district of Pegu it has been stated that there are 10,000 acres under cocoa-nuts.

VI. Bengal.

VI. *In Bengal*, while the palm is plentiful throughout the lower Gangetic basin, it exists only in garden cultivation, and the produce is not much in excess of the local demand. There are no large plantations such as have been described in Madras, Mysore, and Bombay, because in Bengal the date-palm is used as the source of palm-juice or toddy and not the cocoa-nut. It is, however, fairly abundant in Noakhally, Backerganj, Jessore, and the 24-Parganas.

VII. Upper India.

VII. *In Upper India* the cocoa-nut is alluded to in many works, but only as an article of import and export; it is not cultivated. Dr. Hartwig (*Tropical World*) says: "This noble palm requires an atmosphere damp with the spray and moisture of the sea to acquire its full stateliness and growth; and, while along the bleak shores of the Northern Ocean the trees are generally bent landward by the rough sea-breeze, and send forth no branches to face its violence, the cocoa, on the contrary, loves to bend over the rolling surface, and to drop its fruits into the tidal wave. Wafted by the winds and currents over the sea, the nuts float along without losing their germinating power, like other seeds which migrate through the air; and thus, during the lapse of centuries, the Cocoa-palm has spread its wide dominion from coast to coast, through the whole extent of the tropical zone."

VIII. Ceylon.

VIII. *Ceylon.*—Speaking of Ceylon cultivation Mr. Treloar says: "The ripe nuts are first planted in a nursery, where they are covered an inch deep with sand and sea-weed or soft mud from the beach, and watered daily till they germinate. In two or three months a white shoot containing the foliaceous rudiments springs from one of the three holes in the end of the nut; the radicals emerging from the other two orifices opposite to the shoot, and penetrate the ground." This is not quite a correct description of the germination. The leaf-stalk of the cotyledon elongates and pushes the embryo bodily out of the seed. The blade of the cotyledon remains within the nut forming a sort of arm of attachment. The lower point of the projected embryo elongates and forms the roots, and from a slit in the cotyledonar sheath the plumule or stem makes its appearance. The "three holes" on the nut are all close together, not "opposite" as in the above description and are only spots not holes. But Mr. Treloar proceeds: "The nuts set in April, grow large enough in about four months to be planted out before the annual rains, but for the next two or three years or more the young plants require constant care. They must be watered and shaded from the glare of the sun by screens of plaited leaves from the cocoa-nut tree or the fan-shaped fronds of the palmyra."

COIR FIBRE.

COIR FIBRE.

The thick pericarp or outer wall of the fruit yields the valuable COIR FIBRE of commerce. The SHEATHS of the leaves are used to wrap up articles, and as paper to write upon. At the Colonial and Indian Exhibition the writer proposed that they should be tried as a means of strengthening harness, the softer layers being even used for corsets and as surgical splints. The FIBRE OF THE LEAF-STALKS is also prepared, and might prove useful in the manufacture of paper. A delicate TOMENTUM or COTTON is often seen at the base of the leaf; this is used as a styptic. But the most important fibre yielded by the cocoa-nut palm is of course COIR. The name

Leaf-Stalks.

Tomentum.

Coir.

112 COIR FIBRE.

of this fibre is said to come from the Malayalam *káyar* (from the verb *káyaru*, to twist) through the Portuguese corruption *coiro*. "The word appears in early Arabic writers in the forms *kánbar* and *kanbár*, arising probably from some misreading of the diacritical points (from *káiyar* and *kaiyár*)" (*Yule & Burnell*). *Kayer* is said to be also the Tamil for a rope.

Both the fibre and the rope were first exported to Europe about the middle of the sixteenth century, but it was not until the great International Exhibition of 1851 that coir ropes and coir matting attained a commercial importance in England. The merit of this modern trade is largely due to the efforts of the following firms, *viz.*, **Messrs. Chubb, Round & Co.**, and **Messrs. Treloar & Sons** of London; the Oriental Fibre Mat and Matting Co., Highworth, Wilts; and **Messrs. W. I. Sly and T. Wilson** of Lancaster, who were the patentees of improved machinery for making figured fabrics of coir.

Although a considerable amount both of coir fibre and yarn is exported from India, the article, taking India as a whole, is obtained chiefly as a by-product. It is accordingly inferior in quality and colour to the special coir obtained from Cochin, the Laccadives, Madras, Malabar, Ceylon, Singapore, &c. Locality seems to exercise a considerable influence over the quality of the fibre,—soil, climate, and proximity to the sea being important influences. But there are other considerations. Certain varieties or cultivated forms of the cocoa-nut are better suited than others for the production of coir. If cultivated specially for the supply of juice or to afford fruit, the fibre would appear to be in the one case imperfectly formed and in the other overgrown. A great deal depends upon the collection of the fruit at the exact time the fibre is mature, and this followed by an accurate system of steeping, beating, and cleaning the fibre, completes the manipulation calculated to produce the superior qualities of coir. (*Conf. with Mr. Jackson's report in next para.*) "The fibre appears in the market in various degrees of fineness, depending on the age at which the cocoa-nut was cut and husked, and the care bestowed in steeping and cleaning." **Mr. Treloar** says: "The usual indications are that the commoner and coarser fibre comes from the old nuts, and the finer, lighter quality from the new; but there are, of course, essential differences in the qualities brought from each locality, and the Cochin are usually the best." "Here let it be parenthetically but emphatically remarked that *any attempt to give to cocoa-nut fibre a fairer hue by the process of bleaching is to destroy its quality if it be good, and if it be of common quality to make it almost worthless.*"

PROPERTIES OF COIR.

Properties of the Fibre and Season when Mature.—"The Cochin has the purest hue and fetches the best price." On this account it has been customary to imitate this by bleaching. "Cocoa-nut fibre is tough, elastic, springy, easily manipulated within certain limits, and eminently suitable for manufactures where lightness, cleanliness, and great indestructibility are required. It will stand water, is almost impervious to wind and wave, or to damp and rain, and, as we have seen, flourishes in the saline breath of the sea; but it will not stand bleaching. It gives up when confronted with sulphuric acid, chloride of tin, or any other chemicals which are designed to convert it into a sham product. *For this reason we use none but unbleached fibre in any of our manufactures*; and although two or three varied shades of colour are frequently to be seen in one of our ornamental mats, and sometimes form a simple pleasing pattern, they are obtained by combining or incorporating in the same mat different descriptions of *natural* unbleached fibre." *Spons' Encyclopædia* has it that the fibre "is much impaired by waiting for the nuts to arrive at maturity, consequently, for fibrous purposes, the latter are usually cut at about the tenth month. If cut earlier than this, the fibre is weak; if later, it becomes coarse and hard, requires a longer soaking, and is more difficult to manufacture." **Dr. Buchanan Hamilton** in his journey across Mysore states (*I.*, 156)

12 PROPERTIES OF COIR.

the green cocoa-nuts are sold for their husks, from which fibre is extracted, but the husks of the ripe cocoa-nuts are commonly burnt for fuel (*II., 50*). At the same time immense quantities of apparently ripe cocoa-nuts, in husk, are sent to Europe, the coir from the husk being there separated, cleaned, and manufactured. **Mr. Jackson** of Kew, in the *Planters' Gazette*, describing a visit to **Messrs. Chubb, Round & Co.'s** factory, gives an interesting account of the process of husking there pursued. He says: "The enormous heap of husks—which, indeed, is known in the locality as the 'mountain'—comes upon view immediately upon entering the premises, and one can scarcely, at first sight, realise the fact that the enormous pile is composed entirely of these apparently useless portions of the fruit. At the time of my visit this reserve stock of husks was estimated at considerably over a million and a half." Cocoa-nuts, or, as they are generally termed in the trade, "Cocker-nuts," to distinguish them from the **Theobroma Cocao**, which furnishes cocoa and chocolate, are shipped principally from Trinidad, Jamaica, Demerara, Tobago, several of the other Leeward Islands in the British West Indies, Ceylon, Belize (British Honduras), all round the coast of America, and the Fiji Islands. Nearly all the nuts are imported in the husk or outer covering, from which, on arrival, they are stripped by men using two fine-pointed steel chisels, and who, by constant practice, become so skilful in the art that many are able to open 1,000 to 1,200 nuts per day. The nuts themselves after being removed from the husks are generally sold to wholesale fruit dealers, who, in turn, supply the retailers, costermongers and others, &c." In the above passage **Mr. Jackson** has furnished the Indian people with new ideas. India is not enumerated by him as one of the countries that furnish cocoa-nuts to England; *the fibre of what appear to be mature cocoa-nuts is actually used*; the consumption of cocoa-nut kernel has in England attained a vast proportion, and the fibre can be cleaned after apparently having been kept for years on the nut. These facts open up a new field of trade of which with a little assistance the Nicobar and Laccadive Islands might profitably and without fear of any rival hope to enjoy a large share.

(Conf. with p. 213.)

SEPARATION OF COIR.

Separation of Coir in India.—"The removal of the fibre from the shell is effected by forcing the nut upon a pointed implement stuck into the ground; in this way a man can clean 1,000 nuts a day. The fibrous husks are next submitted to a soaking, which is variously conducted. In some places they are placed in pits of salt or brackish water, for 6 to 18 months; in other places, fresh water is used, but it becomes foul, and injures the colour of the fibre. The chief point to be considered is the duration of the soaking; if it be continued too long, the fibre will be weakened; if it be curtailed, the subsequent extraction and cleansing of the fibre will be rendered more difficult. The most approved plan of conducting the soaking is in tanks of stone, brick, iron, or wood; steam is admitted to warm the water. By this means the operation is rendered very much shorter, and the fibre is softened and improved. The further separation of the fibre from the husk is largely effected by hand. After thorough soaking, the husks are beaten with heavy wooden mallets "and then rubbed between the hands." (*Spons' Encyclop.*; **Royle** and **Marshall** give the same facts.)

Robinson describes the separating and cleaning of the fibre as practised in the Laccadive Islands as follows: "When soaked sufficiently long, it is taken out of the pit and beaten with a heavy mallet. Subsequently it is said to be rubbed with the hands until all the interstitial cellular substance is separated from the fibrous portion. When quite clean it is arranged into a loose roving preparatory to being twisted, which is done between the palms of the hands in a very ingenious way, so as to produce a yarn of two strands at once."

"As the husk gets hard and woody if the fruit is allowed to become quite ripe, the proper time for cutting it is about the tenth month. If

12 SEPARATION OF COIR.

cut before this, the coir is weak; if later, it becomes coarse and hard, and more difficult to twist, and requires to be longer in the soaking pit, and thus becomes darker in colour. When cut, the husk is severed from the nut and thrown into soaking pits. These, in some of the islands, are merely holes in the sand, just within the influence of the salt water. Here they lie buried for a year, and are kept down by heaps of stones thrown over them to protect them from the ripple. In others, the soaking pits are fresh-water tanks behind the crest of coral. In these, the water, not being changed, becomes foul and dark coloured, which affects the colour of the coir. When thoroughly soaked, the fibrous parts are easily separated from the woody by beating. If taken out of the pits too early, it is difficult to free the coir from impurities; if left in too long, the fibre is weakened, as is said to be the case also with that soaked in fresh water." (*Robinson's Report on the Laccadives.*) In the Maldives (neighbouring islands under the suzerainty of the Governor of Ceylon) cocoa-nuts are very plentiful, and enormous quantities of both the nut and the fibre are exported to India and Ceylon. (*See the further paragraph on trade in nuts.*)

From what has been said in an early paragraph regarding the cultivation of the cocoa-nut palm in Mysore, it will be seen that the opinion prevails that if tapped for the juice the fruit-bearing is materially injured. If this be a fact ascertained and borne out in other parts of the country, it might be inferred that regions like the Malabar coast, where tapping is largely practised, would not be suited for the production of good fibre. On the other hand, Royle says: "But the fruit-bearing power of the trees may be considerably improved by extracting toddy from the blossom-shoots for the manufacture of jaggery during the first two years of its production, after which it may be discontinued." In the Konkan the opinion is held that "if tapped the trees become unproductive much sooner."

The Bombay process of extracting the fibre is briefly described in the *Bombay Gazetteer* of the Thana district: "The fibrous part of the outer coating is made into coir by the Bassein gardeners. For this purpose the fibres are stripped from the nuts, left under water for two months, and then beaten by a wooden mallet." The writer cannot discover any detailed description of the process adopted in India generally (except that of the Laccadives) for the separation, steeping, and cleaning of the fibre, but to the best of his knowledge it agrees with what has already been given; although in the Laccadives, the Malabar Coast, Ceylon, and other important coir-producing countries, the art is carried to greater perfection, the fibre being correspondingly superior to that prepared on the mainland of India. Large portions of the coast of India (see above in a passage from the *Burma Gazetteer*) are so inaccessible that the methods pursued in Ceylon and elsewhere are scarcely applicable, and, indeed, where applicable, are not pursued, from the greater importance attached to the palm as a supplier of toddy or juice. Dr. Stocks urges that the cocoa-nut might with advantage be cultivated on the brackish soils in the neighbourhood of Karachi, and it seems possible that a coir industry might there be developed. It has been reported that in Madras cocoa-nut cultivation has been successfully prosecuted in the reclamation of salt-impregnated lands where nothing else would thrive. (*Gen. Admin. Report, p. 95.*) A curious fact in regard to cocoa-nuts grown on salt marshes is conveyed by the following passage:—

"The cocoa-nuts growing in mangrove soils, on the side of creeks, and more or less saturated with salt, have their milk brackish, and the sap is saline also. These trees do not suffer from the attacks of the rhinoceros-beetle, and are found to bear much sooner than those planted in a sandy soil" (*pp. 182-83*).

12 TRADE IN COIR.

INTERESTING FACTS CONNECTED WITH THE TRADE IN INDIAN COIR (*Conf. with p. 209*).

Although, as suggested, the better class fibre is most likely not produced where tapping for the juice is practised, still it should not be forgotten that the Malabar ports are the chief seats of the export of coir from India. In most works (written in Europe) on the subject of coir, the statement is made that the best quality comes from "Cochin." As already stated, it is not quite clear, however, whether the Native State of Cochin or the whole of the Malabar coast is meant, or whether Cochin coir is a mere commercial term for all good coir wherever obtained. In the Indian regions alluded to above, cocoa-nut cultivation is prosecuted to a considerable extent. Of Cochin (Madras), it may be said, coir is perhaps the most important article of export from that Native State, but **Dr. Shortt** (*in his Monograph on the Cocoa-nut Palm*) does not apparently mention Cochin coir. He states that the best Madras coir comes from the Laccadives, Amindivi, Kadamat, Kiltan, and Chetlat. As indicated by the passage quoted above from **Mr. Jackson's** paper **Messrs. Chubb, Round & Co.** do not, it would seem, use any Cochin fibre but prefer a husk which they separate from a mature or at least edible nut.

In a recent report on the trade of Madras, the progress of the coir industry of that presidency for the past twenty-five years is shown. The average exports to foreign and Indian ports for the five years ending 1860-61 were 148,220 cwt., valued at ₹3,74,804; and for the five years ending 1880-81, they were 271,934 cwt., valued at ₹21,79,767, while for the year 1881-82 they were ₹23,54,202. Of the last mentioned valuation, the exports from the Malabar coast alone amounted to ₹22,43,000. From these figures a definite idea may be obtained of the immense importance of Malabar and the Laccadives as the chief seats of the Indian coir industry, since the Madras Presidency heads the list of Indian exports. This idea is borne out by the statement made by **Royle** that "the Laccadive Islands are famed for the good quality of the coir which is made there and exported to the Malabar coast." Again, speaking of the peculiar form of the palm grown in the Island of Kiltan, **Royle** observes: "It requires no attention and comes into bearing early. The tree is not so large and strong as that of the coast, and the nut about two thirds of the size only, and round in shape. The husk is smaller and less woody, and the fibre finer and more delicate but stronger than that of the coast nut. The nut is also said to be more compact and oily, and to keep better than the coast nut, although, for the sake of the coir, the nut is cut before being quite ripe." How far the exports of coir from the Malabar coast correspond to Indian-grown coir cannot be discovered. The Northern Laccadives are administered by the Collector of Malabar and the Southern by Alí Rájá of Cannanore. **Sir W. W. Hunter** in the *Imperial Gazetteer* (*VIII., 394*) says: "The article (coir) is paid for to the producers at fixed prices, and is sold on the coast at the market rates; the difference constitutes the revenue or profits of trade of the Government and Alí Rájá respectively. The latter pays a fixed tribute of ₹10,000 (£1,000) to the Government on account of the islands which he manages. No change has been made for many years in the price which is given by Government for the coir produced in the islands attached to Kánara." The returns of the coasting trade of India do not specify the amounts of coir sent from the Laccadives to Malabar, so that the somewhat interesting subject of how far the juice-extracting industry of the coast is combined with the preparation of fibre cannot be definitely learned. The following facts are, however, instructive.

Imports.

IMPORTS of coir (manufactured and unmanufactured) into Madras from other Indian ports—

	Cwt.	₹
1884-85	14,745	95,884
1886-87	13,750	81,386

EXPORTS to other Indian ports— 12 Exports

	Cwt.	₹
1884-85	186,869	12,66,356
1886-87	128,228	7,98,255

Turning to the tables that give the details of these figures, it is shown that of raw or unmanufactured coir Madras receives none from British or foreign Indian ports, so that unless the Laccadives, which (as stated above, are treated as part of Malabar), furnish a very large amount, a considerable local production must exist on the Malabar coast to allow of the extensive exports given above, and the still larger exports shown in the returns of foreign trade. In the *Imperial Gazetteer* it is stated of the Malabar district alone that "the value of exported cocoa-nut products is estimated at nearly a million sterling annually."

In a previous page some indication of the extent of the Nicobar trade in cocoa-nuts has been given. There does not, however, appear to be any trade in coir, although it seems possible that one of the inducements that bring the native and other crafts from Ceylon and the Straits, for the cheap Nicobar cocoa-nuts, may be to use these in supplementing their home supplies—supplies which are in much demand in the coir market. It may be worth while suggesting that an effort might with advantage be made to instruct the natives of the Nicobars in the art of preparing the coir fibre—an art so profitably practised by their neighbours, the islanders of the Laccadives. This is indeed one of the most hopeful aspects of a possible enhanced Indian trade in coir, until such time as the cultivation of the palm can be more vigorously prosecuted along the Coromandel coast to Burma. It seems remarkable that the cheap cocoa-nuts sold in the Nicobar Islands should attract traders from Ceylon and the Straits, while India appears to make little or no effort to participate in the advantages of that trade. This is perhaps due to the administrative arrangement which has associated the Maldive Islands with Ceylon instead of India, the Ceylon traders calling at the Nicobar as well as the Maldive Islands.

YIELD PER NUT OF FIBRE AND PRICE.

YIELD OF FIBRE.

Mr. Robinson, in his *Report on the Laccadives*, states that the difference in the quantity of coir manufactured from a coast nut and from an island nut is very considerable. We may premise that 40 cocoa-nuts are said to yield 6lb of coir in Ceylon. **Mr. Robinson** remarks: "Three large coast nuts will yield 1lb of coir measuring 22 fathoms; whereas, ten small, fine island nuts go to about 1lb of coir, but this will measure 35 fathoms: 2lb of such yarn, measuring from 70 to 75 fathoms, are made up into *sooties*, of which there are 14 to a bundle, averaging about a maund of 28lb. A Mangalore candy of 560lb will thus be the produce of 5,600 nuts, and should contain about 20,000 fathoms of yarn. The actual price of coir received by the islanders is about ₹13 per candy. The value of the coir produce of a tree is calculated to be from 2 to 2½ annas; and that of the produce of 100 trees from ₹13 to 15." "The average value of the total raw produce of a tree bearing fruit would then be seven annas to half a rupee; and that of a plot of 100 trees, ₹45." For the nuts which they export to the Malabar coast they get from ₹7 to 10 per thousand, or rather 1,100, as 10 per cent. is always allowed for luck in these sales. The islanders export from 300,000 to 400,000 nuts annually. The natives bring their coir to the coast in March and April, which is then received into the Government godowns. Until the year 1820 all coir was paid for at the rate of ₹21-14-0 per Mangalore candy, or ₹25 per Calicut candy of 640lb. After that year the coir was divided into three classes. Since then the average price paid for a Mangalore candy of Ameendevy and Kadamat coir has been ₹20-2-0 (or ₹23 per Calicut candy of

PRICE.

12

640lb). But for the Kiltan and Chetlat coirs, which are the best, an average of R20-12-7 or R23-12-0 per Calicut candy is paid. Up to A.D. 1825-26, the Bombay and Bengal Governments took almost the whole of the coir brought from these islands, and credited the Mangalore Collectorate with R25 per candy. The price has since fallen very much during the last twenty years. It has been frequently below the price paid to the islanders, and at best has never yielded above 12 to 20 per cent. profit. The average imports of coir have been from 500 to 600 candies. **Mr. Morris**, in his account of the Godavery district, Madras, gives the following brief statement regarding the production and yield of coir :—

"The cocoa-nut tree yields an excellent fibre. The quantity of fibre in the above extent of land (a *puttí*) is estimated at 150 maunds, yielding R93-12-0, at 10 annas a maund. The fibre is prepared by the outer covering of the cocoa-nut being moistened and beaten with wooden mallets, after the fibre has thus been loosened. The coir thus obtained is twisted into ropes. The fruit is exported, but very little of the fibre" (*Morris's God. Dist.*, 70).

Spons' Encyclopædia gives the London prices of coir as "Cochin—good to fine, £19 to £25 a ton; coarse, £16-10*s.* to £19-15*s.* Yarn—good to fine, £26-10*s.* to £46 a ton; medium, £21-5*s.* to £28-10*s.*; common, £14 to £22-10*s.*; roping, £18 to £24."

USES OF COIR.

Uses of Coir.

"The fibrous husk of the cocoa-nut is not its least valuable product, and gives rise to a very large trade, both in the East and in Europe. At first it was only used in this country (England) for stuffing mattresses and cushions, but its applications have been enlarged and its value greatly increased by mechanical processes, and in a small pamphlet issued by **Mr. Treloar**, more than twenty years ago, he stated that its natural capabilities having been brought out, coir has been found suited for the production of a variety of articles of great utility and elegance of workmanship—table-mats, fancy baskets, and bonnets, &c. Instead of being formed into rough cordage only, and mats made by hand, by means of ingeniously-constructed machinery the fibre is rendered sufficiently fine for the loom, and matting of different textures and coloured figures is produced, while a combination of wool in pleasing designs gives the richness and effect of hearth-rugs and carpeting. Brushes and brooms for household and stable purposes, matting for sheep-folds, pheasantries, and poultry yards, church cushions and hassocks, hammocks, clothes lines, cordage of all sizes, and string for nurserymen and others, for tying up trees and other garden purposes; nosebags for horses, mats and bags for seed-crushers, oil-pressers and candle-manufacturers, are only a few of the varied purposes to which the fibrous coating of the cocoa-nut is now applied." (*Simmonds, Trop. Agri.*, 234.) The uses of coir are of course so varied and extensive that it is scarcely necessary to enter upon them in greater detail than indicated in the above passage. To the natives of India it is invaluable as lasting in a damp climate. It is accordingly universally employed in tying the bamboos used in the construction of their huts.

Fibrous Sheaths.

Fibrous Sheaths of the Leaves and Cocoa-nut Cotton.—A brief reference has been made to these in an early part of this article. The finer ones are used as filters and sieves, but the coarser are apparently put to no purpose, although they have been proposed as suitable for paper-making. They might be used to strengthen saddlery, and even for ladies' corsets and splints. **Knox** says of Ceylon that "the filaments at the bottom of the stem of the cocoa-nut may be manufactured into a coarse cloth called *gunny*, which is used for bags and similar purposes."

On the young sheaths and petioles a brown-coloured cotton or tomentum will be seen similar to that already described under **Borassus**

flabelliformis (B. 680). This is sometimes collected and used by the natives to stop bleeding from wounds. A good sample of it was shown at the Colonial and Indian Exhibition.

Cadjans.

CADJANS.—"The leaves are plaited into mats and screens and also made into baskets, and combs are said to be made of the midrib of the leaflets in the Friendly Islands. In the Laccadive Islands mats are made of the cocoa-nut leaf. These mats are of fine quality and much esteemed when exported. In the islands they are employed for the sails of the smaller boats." "The Singalese split the FRONDS in halves, and plait the leaflets neatly, so as to make excellent baskets, and under the name of *cadjans* they form the usual covering of their huts, as well as of the bungalows of the Europeans." "The dried fronds are sometimes used as torches or for fuel; their midribs, tied together, are sometimes used as brooms for the decks of ships, as the fibres of the stalk are woody, brittle, and difficult to clean." (*Royle.*)

Fronds.

COLLECTIVE TRADE IN COCOA-NUT PRODUCTS.

TRADE IN COCOA-NUT PRODUCTS.

This trade, as with every other article of Indian produce or manufacture, is referable to three great sections: (*a*) internal trade or local consumption; (*b*) inter-provincial trade adjusting the balance of local demand; and (*c*) foreign trade (*e.g.*, imports and exports) to and from India and other countries. Where the cocoa-nut grows it is of such importance and enters so largely into the daily life of the people, that little or nothing can be ascertained of the actual consumption. The returns of road, river, and rail traffic throw some light on this, and the coasting trade affords another means of arriving at an approximate estimate of a certain proportion; but even these returns fall far short of establishing a tangible conception of the total local consumption. Wherever the palm grows, each villager, as a rule, has some trees, the produce of which is used up by himself or sold to his less fortunate neighbours, without having to go many yards from the spot where produced. At the same time, a considerable amount of the inter-provincial exchange must necessarily figure again under foreign exports, or at most re-exports, so that while the returns of foreign trade indicate but a very small proportion of the production, it would be unsafe to reckon these up with the available returns of coasting and inter-provincial trade. To give some idea of the present position and growth of the trade in the cocoa-nut palm it will not be necessary to go further back than the year 1850. Royle, in his *Fibrous Plants of India*, gives the imports and exports for that year compiled from the records of the Statistical Department of the India Office. Accepting these as correct (remarking only that a certain amount of the coasting trade is included by that author with the foreign trade) we may summarise his results in the following statement:—

All published Imports and Exports for 1850.

	Imports.	Exports.
	R	*R*
Nuts	5,24,889	10,140
Kernels	8,66,120	4,31,008
Coir and rope	2,31,934	2,84,514
Oil	76,648	1,51,843
Shells	5,970	*Nil*
Cadjans	2,990	*Nil*
TOTAL	17,08,551	8,77,505

12 COLLECTIVE TRADE.

This gives a grand total of R25,86,056; that is to say, less than the foreign imports of last year. To compare with the above statement of TOTAL TRADE, the following table of the FOREIGN TRADE for 1886-87 (exclusive of all internal and inter-provincial or coasting traffic) may be given:—

Foreign Imports and Exports for 1886-87.

	Imports.	Exports.
	R	R
Nuts	5,98,203	8,462
Copra (or kernels)	11,76,799	79,836
Coir (unmanufactured)	6,839	77,391
„ (manufactured but exclusive of ropes)	1,50,701	19,14,448
Oil	7,54,515	13,24,589
TOTAL	26,87,057	34,04,726

If to the above table of foreign trade we were to add the returns (included by Royle) of coasting trade from Malabar, the Laccadives, Coromandel, Konkan, &c., the comparison would be brought out still more forcibly, but, as the tables stand, the foreign imports and exports to and from India of cocoa-nut products were last year valued at over 60 lakhs of rupees, whereas in 1850 (removing approximately the items of coasting trade) they were considerably less than one third that amount. The most striking feature of this development has been the growth of the trade in manufactured coir and in oil. As far as the returns of foreign trade indicate, it would appear that the imports and exports of cocoa-nuts and of *copra* or *khoprá* (a commercial name for the kernels) have remained stationary during the past forty years. How far the returns of foreign trade can be accepted as an indication of total trade may be learned from the following statement of the values of the coasting trade in cocoa-nut products during the year 1886-87:—

Coasting Trade in	Imports.	Exports.
	R	R
Nuts	24,21,941	16,88,773
Kernels (copra)	35,31,115	23,00,958
Coir	12,20,749	9,27,302
Oil	20,60,067	20,74,455
TOTAL	92,33,872	69,91,488

The table furnished by Royle for the trade in 1850 practically corresponds to the two last-given tables conjointly, so that instead of 25 lakhs the present sea-borne trade has expanded until it may now be returned as valued at 223 lakhs of rupees. It has been remarked that a certain amount of the inter-provincial coasting traffic may reappear as exports to foreign countries or figure in the road, river, and rail traffic to interior parts of the country. While, therefore, the estimate of 223 lakhs must include duplex if not multiplex returns (*e.g.*, Bengal imports from Malabar figuring again as exports to foreign countries or re-exports to other Indian provinces), Bengal at the same time produces cocoa-nuts and the rail and river traffic from Bengal to Assam, the North-West Provinces, the Central Provinces, Central India, and even the Panjáb, may be viewed as very considerably in excess of the overlappings of sea-borne traffic. Take by way of

12 COLLECTIVE TRADE.

illustration one item of this internal trade: Bengal sent to Assam in 1883-84 cocoa-nuts to the number of close upon two millions, valued at ₹69,000. In a like manner Bombay imports cocoa-nut products from Madras, Ceylon, Zanzibar, &c., and distributes doubtless a large proportion of these inland, competing with Bengal for the central tracts of India where the palm does not grow, but at the same time Bombay produces a large quantity of cocoa-nuts locally, and these are added to the foreign imports in the competition of the Indian internal trade. The importance of the internal trade may further be demonstrated by the fact that while Madras exports far more to foreign countries than all the other provinces put together (and indeed it takes the largest slice in the coasting export trade), it receives by sea practically no cocoa-nut products. Its entire supplies of Malabar and Laccadive fibre and copra seem to be conveyed to the port of shipment by internal means of transport. India is itself perhaps the largest consuming country in the world for cocoa-nut products, so that, recollecting this fact, a conception of the total trade may be had by adding to the sea-borne traffic an allowance for local production. Even when this has been done, a very imperfect idea will have been obtained of the value of the tree to the people of India. The mere returns of trade cannot give a just conception of the importance of a product which, like the cocoa-nut, to a large population, may be said to be their source of wealth as well as their food, drink, and occupation.

Trade in Coir, manufactured and unmanufactured.

In all the returns of this subject care is taken to explain that these do not include ropes—coir ropes and cords being placed under a general heading with all vegetable cords.

I. The exports of Raw Coir are, however, so insignificant that a false impression is likely to be conveyed. The so-called manufactured coir, which figures extensively in the returns, appears to be largely crude coir yarn which is dressed and employed by the European manufacturers, but of course a considerable trade is also done in mats, rugs, carpets, and other such manufactures. Glancing at the figures of the foreign trade in Coir (unmanufactured), the trade would seem to have practically remained stationary for many years past, and to be too small to justify the conclusion that India participates anything like to the extent it might in meeting the home market. The exports have averaged from 10,000 to 15,000 cwt. for the past twenty years: they were last year 12,347 cwt., valued at ₹77,391; but in 1883-84, they reached to 20,098 cwt., valued at ₹1,59,683. The foreign imports of coir are from Natal and Ceylon, and the bulk of these go to Bengal. The coasting trade last year conveyed from one Indian port to another the following quantities of unmanufactured coir: Imports 18,052 cwt. and exports 17,733 cwt. Of this trade, Madras exported 15,586 cwt. and imported only 309 cwt., Bombay exported 2,146 cwt. and imported 8,836 cwt., while Bengal exported only 1 cwt. but imported 8,335 cwt. The bulk of the Bombay and Bengal supplies came from Madras (*viz.*, 5,756 cwt. and 7,645 cwt. respectively). Of the exports to foreign countries the United Kingdom received 10,215 cwt. of last year's production, and of that amount 8,940 cwt. were consigned from Madras.

II. Of Manufactured Coir (excluding ropes) India imported last year (18,709 cwt.) valued at ₹1,50,701 and exported 208,622 cwt., worth ₹19,14,448. Of the imports, Ceylon sent 17,657 cwt., of which Bengal received 11,956, valued at ₹1,22,552. Of the exports, Madras sent to foreign countries 168,678 cwt., valued at ₹15,69,774, Bombay and Bengal each sending about 20,000 cwt. Of these exports the United Kingdom received 186,395 cwt., valued at ₹17,32,815, and next in importance followed France, 9,836 cwt., the United States, 2,621 cwt., Australia, 2,485 cwt., and Arabia, 2,545 cwt., &c.

12 COLLECTIVE TRADE.

Of the coasting trade in manufactured coir the imports and exports from one province to another were—imports 150,396 cwt., valued at R11,16,957, and the exports 134,665 cwt., valued at R8,36,427. Of these, Bengal received 60,500 cwt., Bombay 74,561 cwt., Sind 1,776 cwt., Madras 13,441 cwt. The Bengal and Bombay imports came mainly from Madras and Travancore, Cochin ranking next. The importance of Travancore as a seat of the coir-manufacturing industry may be demonstrated by its imports into Bengal and Bombay; Madras sent 30,185 cwt., valued at R2,61,199, and Travancore 27,613 cwt., valued at R2,86,277; to Bombay, Madras sent 50,264 cwt., valued at R2,72,567, and Travancore 17,327 cwt., valued at R1,40,260. At the same time Madras last year sent a large amount to Travancore, *viz.*, 14,283 cwt., valued at R1,36,810. Of the total exports in the coasting trade (*viz.*, 134,665 cwt.) Madras sent to other ports 112,642 cwt., and Bombay, next in importance, exported only 21,647 cwt. Of the total coasting trade in imports (*viz.*, 150,396 cwt.) Bombay generally heads the list; it received last year 74,561 cwt., while Bengal took 60,500 cwt., being followed by Madras with 13,441 cwt. Sind and Burma are unimportant; the former received only 1,776 cwt. *Thus it will be seen that both in foreign and internal trade the coir industry is mainly concentrated in the Madras Presidency.*

COIR ROPES.

Coir Ropes.

Nothing can be learned as to the extent of the foreign and internal trade in coir ropes and cords, since the trade returns for these are published jointly with those of all other ropes. It has been said, however, that coir string is universally employed by the natives of India in the construction of their bamboo huts. For this purpose alone the consumption must be enormous. The merits of coir as a rope fibre are now fully appreciated throughout the world, the elasticity and lightness of the fibre making it eminently suited for this purpose. But to these properties has to be added its great power of withstanding moisture even under continued actual submersion. On these grounds it is in great demand for maritime purposes as hawsers, although its roughness renders it unserviceable for standing riggings, its elasticity being for such purposes a disadvantage. It is, however, better suited for running riggings, its lightness being taken advantage of. In the *British Manufacturing Industries* (on Fibres and Cordage) it is stated, "Coir is one of the best materials for cables on account of its lightness, elasticity, and strength. It is durable and little affected when wetted with salt water. Numerous instances have been related of ships furnished with this light, buoyant, and elastic material riding out a storm in security, while the stronger-made, though less elastic, ropes of other vessels have snapped in two. Of coir and coir-made rope, about 9 or 10 million pounds are annually shipped from India. Much of it is prepared in Ceylon, but Cochin is noted as the port of shipment for the best quality of yarn, and many thousand cwt. are annually exported from there." This statement of many thousand cwt. being shipped from Cochin should be compared with the trade returns quoted and the remarks made in an early paragraph. In *Spons' Encyclopædia* the following opinion is given of coir fibre for the purpose of cordage: "In Dr. Wight's experiments, coir cordage broke at 224lb. Though not superlatively strong, the elasticity of the fibre, and the capacity it exhibits of withstanding the action of sea-water, render it valuable for cordage purposes, to which it is widely applied locally, besides being less extensively imported into this country for a similar use." Messrs. Harton & Co., of Calcutta, placed in the Colonial and Indian Exhibition a trophy of ropes of which a striking feature was the arches of hawsers, 12 inches in diameter, thrown across the path; some of these were made of coir.

REGIONS WHERE COIR SHOULD BE PROCURED. 12

To the merchant desirous of starting a new or extending an existing trade, the question of primary importance to which he calls for a reply is the province or district with which he should open up dealings. The chief products of the cocoa-nut are coir-fibre, oil, and toddy, or the juice from which sugar and spirits may be prepared. We know that in Bombay the juice is largely extracted from the tree, that in Mysore the fibre is the chief preparation, and that in Madras and Travancore enormous quantities of both fibre and oil are exported; while Bengal, on the other hand, imports immense numbers of cocoa-nuts and a large quantity of copra, but exports very little of the products of the palm. It can nowhere, however, be discovered whether any two of these primary products or all of them, can be derived from the same trees or even prepared by the same cultivators—certain plants or portions of the plantation being periodically set apart for these several industries. Under coir fibre it has been said that the green or unripe cocoa-nut is alone used for that purpose, while most writers seem to agree that the ripe kernel is necessary for the oil. It would be most instructive to know if cultivation had resulted in the production of certain races of cocoa-nuts famous for their oil-yielding properties, just as the inhabitants of the Laccadive Islands appear to have developed a small-fruited one with a specially good fibre. In connection with commercial reports on cocoa-nut oil it is generally stated that the finest qualities are obtained from "Cochin." (**Spon** places Cochin after Ceylon.) It will be recollected that this same statement occurs regarding the fibre derived (or supposed to be derived) from that Native State. The writer has failed to discover any account of the Cochin oil industry, and is almost forced to the opinion that by "Cochin cocoa-nut oil," as with "Cochin coir," may be meant the superior qualities of the oil derived from the Madras Presidency. If ripe cocoanuts are essentially necessary for the preparation of the oil, then the Maldive and Nicobar Islands might be looked to as the great seats of the oil industry. But while these islands export perhaps little short of from 15 to 20 million ripe cocoa-nuts a year, they do not appear to manufacture cocoa-nut oil, *and the ripe husks are of no use for fibre.* So, in a like manner, the Laccadives would not be looked to as a source of oil: these islands are famous for their coir, the inhabitants growing a peculiar cocoa-nut that would seem to be inferior to the Malabar either as an oil-yielding or an edible nut. The imports from the Maldives and Nicobar Islands into Madras are very unimportant as compared with those recorded against Bengal, yet Madras, and not Bengal, appears to control the cocoa-nut oil market. This fact would lead to the inference that the locally grown nuts of Madras were largely employed for the expression of oil—the very considerable imports from the Laccadives affecting mainly the coir industry. But if this inference be correct, there remains the difficult position that the ripe nuts, serviceable for oil-making, yield no fibre. The presumption would therefore appear to be that a very much larger amount of the Madras coir comes from the Laccadives than we have any definite knowledge of at present, or that a large proportion of the coast cocoa-nuts or those of certain localities only are always or periodically set apart for oil-yielding. It may, of course, be the case that the trees are, so to speak, pruned by the removal for coir of so many green nuts from each tree, the remainder being allowed to ripen for oil purposes or as articles of diet.

[Conf. with p. 204.]

This brief review, from want of definite information, may be accepted as indicating the direction that future reports might assume; but it may safely be concluded that, as with coir, so with cocoa-nut oil, Madras is the chief seat of the trade.

CONCLUDING NOTE.—Since the above account of the fibres obtained from this palm appeared in the *Dictionary of the Economic Products of India*, the writer has come across **John Huyghen Van Linschoten's**

12 most interesting account of the Cocoa-nut palm which appeared in his *Voyage to the East Indies*, and was published in 1596. One might be almost disposed to say that Linschoten's account, written 300 years ago, contains as much information as any one of the numerous subsequent reports which have appeared. After describing the palm, its natural habitat, mode of cultivation, and the numerous uses to which it is put, he enters into great detail regarding each of its chief products. The toddy, sugar, oil, copra, edible nut, and milk are each separately dealt with, and of the oil he says there are two kinds—that prepared from the green nut and that from the sun-dried copra. What, perhaps, surprises one more than anything else with Linschoten's life-like picture, is the fact that not only are the self-same systems pursued at the present day in the cultivation of the palm and the utilisation of its products, but the names now in use for each and every part and process are there given by this early Dutch writer. Two passages may be here extracted from Linschoten's description of the fibre: "The profits they reape thereby are these: First, the wood is very good for many things, although it be spungious [and sappy] by reason of the length of it, for in the Islandes of Maldiva they make whole ships thereof, without any iron nayles in them for they sow them together with the cordes that are made of the said Cocus [or Nut], the ropes and cables being likewise of the same tree, as also the sayles which they make of the leaves, which leaves are called Olas. They serve likewise to make the Canarijns houses, and for hattes which they use to carrie over their heades, for the sunne or the raine, they make also mattes or tents that lie over the Palankins, when it raineth, to cover the women when they are carried abroad and such like thinges; they likewise make thereof very fine Hattes, that are much esteemed, and cost three or foure Pardawes the peece, which they weare in summer for lightness." * * * *

"This Huske beeing drie and pulled off, is haire like hempe, whereof all the cordes and cables that are used throughout al India are made, as well upon the land as in the ships, it is of colour verie like the ropes of Sparta in Spain, they are very good but they must be kept in salt water, whereby they continue very long, but in fresh or raine water they doe presently rot, because they are not drest with pitch and tarre [as our ships are]. The ship wherein I came out of India into Portingall, had no other ropes nor cables [nor any such kinde of stuffe], but such as were made of the Indian Cocus called Cayes, which continued very good, saving only that we were forced every fourteene days to wash our cables in the Sea, whereby they served us as well as cables of hemp." Compare the above account of mast, sails, &c., made of Cocoa-nut leaves with the paragraph (p. 209) under Cadjans.

Linschoten's account of palm leaves used for writing on may be read with interest. It may be doubted, however, how far Cocoa-nut leaves were used for this purpose, and as he makes no mention of the Palmyra palm (**Borrassus flabelliformis**), it was probably in his day, as at present, the leaves of that palm and not the Cocoa-nut that were used.

"This the Indians use for paper, and bookes, which continueth in the same foldes, whereon they write when it is greene and so let it drie, and then it is impossible to get the letters out againe, for it is printed therein with a [kind of] Iron instrument: the Indians call it Olla, whereof all their bookes, wrytinges, and Evidences are made, which they can seale, and shut up as we doe our letters. Of this Paper with the Indian writing upon it, you may see some at D. Paludanus' house, which I gave him for a present. These trees are for the most part in the Islands of Maldiva."—*Ed.*

GEORGE WATT,

Simla, December 1888. *Reporter on Economic Products.*

VOL. I.; PART II. (No. 15); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

The following pages have been simply struck off from the same type as the Jute article in the *Dictionary of Economic Products*. This has been thought necessary so as to complete the present part of the Selections as a special pamphlet on the more important fibres of India.

G. WATT,

Reporter on Economic Products.

Simla, November 1888.

CORCHORUS, *Linn.; Gen. Pl., I., 235.*

The generic name for this group of annual plants is derived from the property of the leaves (κορη the pupil of the eye, and κορηω to purge or clear). There are about 36 species distributed throughout the tropics, of which India possesses 8. But so uniformly are these plants met with in Asia, Africa, and America, that geographical evidence does not come to the aid of the student who may desire to work out the history of the cultivated species. The following are the Indian species regarding which economic information is available, but any one of them may be used for the fibre contained within its bark, since all are rich in fibre. Writing of the edible properties of the species of CORCHORUS, **Mr. Hem Chunder Kerr** says: "Some of the plants yield leaves that are excessively bitter; others slightly so. The former, called *tikta nálitá*, according to the *Rájavallabha*, a modern medical treatise, is a specific against red eruptions, worms, and leprosy. The latter, *madhura*, cures cold, paralysis, phlegm, and wind; both of them are esteemed as good tonics. The middle and higher classes of the people take them boiled with other vegetables in the form of soups as stomachics or appetizers; the lower classes use them as articles of food." **Sir Walter Elliot** gives **C. olitorius** the Telegu name of *Périnta kúra* but makes no mention of **C. capsularis**, but *Patti* he says is the vernacular for **Gossypium herbaceum** and *Pátta* for **Cissampelos Pareira.** The confusion that exists in the literature of Corchorus and of Jute has suggested the desirability of giving the characters which the writer accepts as separating the more critical species. It seems highly probable that hybrid or intermediate forms exist, however, connecting most of the Indian types. The peculiarities of the seed would seem to afford a better means of distinguishing the species than the form of the beak or number of cells and presence or absence of septæ in the capsule.

3. Corchorus acutangulus, *Lam.; Fl. Br. Ind., I., 398; Wight,* [TILIACEÆ.

Syn.—C. FUSCUS, *Roxb., Fl. Ind., Ed. C.B.C., 429, Ic. t. 739.*

Vern.—*Títápát*, BENG.

References.—*Dalz. and Gibs., Bomb. Fl., 25; Kurz, Contrib. Burmese Fl., 130; F. von Müeller, Sel. Extra-Trop. Pl., 88.*

Botanic Diagnosis.—Stem hairy along certain sides between the nodes (not all round), the whole petiole having spreading hairs, and being woolly along the upper surface, both surfaces of the leaf hairy, those of the upper adpressed, margin often minutely ciliate; nervules reticulate (not parallel anastomising, as in **C. olitorius**). Capsule short (1 inch long at most); winged, beak cleft into 3-4 spreading arms each, often bifid; base of capsule contracted, position of faded flower indicated by a sharp groove. Seeds small, broader than long, squarish; hilum a large thickened patch in one corner.

A very distinct, and perhaps the most abundant wild species in India, often mistaken for **C. olitorius** when not in fruit.

Habitat.—An annual herb, met with throughout the hotter parts of India and Ceylon. **Roxburgh** remarks that it flowers during the rainy and cold seasons, is never cultivated, and differs from **C. tridens**, *L.*, in having only one style; and from **C. trilocularis**, *L.*, in having only one row of seeds in each cell. **Dalzell and Gibson** say that in Bombay it is a common weed, and **Roxburgh** that it is a native of various parts of India. **Kurz** states that it is frequent in the leaf-shedding forests all over Burma up to 3,000 feet elevation. **Stewart** apparently treats **C. acutangulus** as a synonym for **C. trilocularis**, and gives *báphallí* as the vernacular for the plant, and *isband* as the bazar name for the seeds. Not only is the above association of the scientific names incorrect, but *báphallí* is the name given to **C. Antichorus**, and *isband*, the seeds, to **C. trilocularis.**

Mr. Hem Chunder Kerr speaks of this as "the species C. fuscus, or the *títá* variety of C. capsularis." It would almost seem possible that from C. acutangulus and C. trilocularis the cultivated forms of jute might have been produced. At all events, C. olitorius so closely resembles this plant in foliage that many of the reputed instances of C. olitorius having been found wild may be traceable to a mistake made in viewing C. acutangulus as C. olitorius. The beak in Clarke's C. olitorius No. 23,613 is hooked, the tips spreading somewhat as in C. acutangulus. Duthie's 7,121 has "the foliage, capsules, and hairs of C. trilocularis with the seeds of C. olitorius." 3 JUTE.

Fibre.—A coarse fibre is sometimes extracted from this species and Müeller alludes to this plant as an occasional source of jute. FIBRE.

[*t. 1073.*

Corchorus Antichorus, *Rœusch.; Fl. Br. Ind., I., 398; Wight, Ic.,*

Syn.—CORCHORUS HUMILIS, *Munro*; ANTICHORUS DEPRESSUS, *Linn.*

Vern.—*Baphuli*, HIND.; *Baphúlli, kúrand, bophalli, bahúphalli, babuna*, PB.; *Mádhiri*, SIND.

References.—*Dals. & Gibs., Bomb. Fl., 25; Murray, Pl. & Drugs, Sind, 65.*

Habitat.—A common prostrate, shrubby, plant, wild in Upper India, from the N.-W. Provinces to the Panjáb and Sind, and south-west to Káthiáwár, Gujrát, and the Deccan—a member of the Indian desert flora. Distributed to Afghánistan, Aden, Tropical Africa, &c.

Fibre.—A very indifferent fibre may be prepared from this species. FIBRE.

Medicine.—Stewart says the plant is rubbed down and given as a cooling medicine; Murray that in Sind its mucilaginous property makes it a valued demulcent, which is used in the treatment of gonorrhœa. MEDICINE.

Fodder.—Stocks mentions this plant as a desert fodder-plant, eaten by camels. FODDER.

3. C. capsularis, *Linn.; Fl. Br. Ind., I., 397; Wight, Ic., t. 311.*

Vern.—*Ghi-nalitá-pat* (according to Roxburgh); *Narchá* according to U. C. Dutt), BENG. The last mentioned author in the Glossary to his Mat. Med. of the Hindus gives this plant the Sanskrit name *kálasáka.*

In Bengal the words *pát* and *koshtá* are often given to both the jute-yielding species, or to the fibre obtained from them, the latter word being apparently derived from the Sanskrit *kosha*, a sheath, in allusion to the fibres surrounding or sheathing the stem. But if this be a correct derivation for the word, it is in its meaning equally applicable to hemp and sunn-hemp, in fact to any fibre obtained from the bark, or even to silk in the cocoon, and can have no specific application to jute. From *Nádika* has most probably been derived Nálitá, the spinach prepared from the leaves. (*Conf.* C. olitorius.) The word, *kosta* in Dacca means a handful of jute, and *kakla*, a corruption from it, is given to the fibre dried on the stems instead of being separated by retting. One writer even suggests that *koshta* may be derived from Kooshtia, the name of a district in Eastern Bengal, where a considerable amount of jute is produced. This is probably fanciful, but it is worth adding that the word *koshta* is only used in Eastern Bengal, and that the name Kooshtia is probably not a very ancient one.

Harrana is a name given in Sháhjahanpur District, N. W.-P. (according to Mr. J. F. Duthie), for this species. Mr. Hem Chunder Kerr says that in Orissa, for both the jute-yielding species, the following names are used: "*kowria* and *nálitá*, other names being *naskarkáni, kostra, kangra, kanta, tita, beral*, and *hanuman*; but whether they are mere local names of these plants or of their different varieties, or of other plants confounded with the jute-producing species, it is uncertain." Dr. Bidie failed to find Tamil or Telugu names for C. capsularis during an enquiry instituted in 1874 into the subject of the jute cultivation in Madras.

CORCHORUS capsularis. **The Round Fruited Corchorus.**

3 JUTE.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 429; Loureiro, Fl. Cochin Ch., VI., 408; Rumph., v. t. 78, f. 1; Voigt, Hort. Sub. Cal., 127; Brandis, For. Fl., 37; Gamble, Man. Timb., 52; Kurz, Contrib., Burm. Fl., 130; Lisboa, U. Pl. Bomb., 230; U. C. Dutt, Mat. Med. Hind., 302; Thwaites, En. Cey. Pl., 31; Proceedings, Madras Govt. (Rev. Dept.) 1874, No. 49; DeCandolle, Orig. Cult. Pl., 131.*

Botanic Diagnosis.—Alone distinguishable from **C. olitorius** by the short rounded capsule—a very unimportant character. **Gamble's** No. 15,912 has one capsule nearly round, while the others are distinctly those of **olitorius**, but some are 4-valved, others 5-valved. **Kurz's** No. 1231 of **C. acutangulus** has both 4- and 5-valved capsules, and **Clarke's** No. 24,899 has a 3-valved capsule. **Clarke's** No. 31,637 of **C. trilocularis**, has a 4-valved capsule, and **Hooker and Thomson's** sample of that species, from the Panjáb, has a 3-valved capsule. The capsule is thus variable.

Habitat.—A common plant "throughout the hotter parts of India." This statement, originally made by **Roxburgh**, is current in the literature of jute. While it need not necessarily be implied that a plant is wild (*e.g.*, indigenous) in the area where it is common, still that is the opinion popular writers have derived from the above carefully worded botanical description. The major portion of all we have learned regarding **Corchorus capsularis**, during the past century, leads to the opposite conclusion. There are, however, a few notices of the plant that point either to its being indigenous in India or indicate acclimatisation so successful as to have deceived modern botanists. **Mr. J. F. Duthie** has, for example, favoured the writer with a note to the effect that he found **C. capsularis** on the banks of the Gumpti near Judalpur in what appeared a wild condition. A Native of the place gave the plant the name of *Harrana*, a word which has no relation to any of the names given to the Indian species of **Corchorus** in other parts of the country. **Mr. W. A. Talbot**, in a list of the Kanara plants (*Bomb. Gas. XV., I., 428*), states of this species that it is "found on road-sides sparingly throughout North Kanara." On the other hand **Dr. Prain** (Officiating Superintendent of the Botanic Gardens) has forwarded to the writer, for personal inspection, every sheet of **Corchorus** from the Calcutta Herbarium on which the word "cultivated" has not been inscribed. It is a remarkable fact that **Dr. Prain** should have had to say: "All our **C. capsularis** are plainly cultivated, except perhaps one by **Kurz** from the Pegu Yomah, Burma, which, however, may be an escape." **Kurz** himself says of **C. capsularis** (*Contrib., Knowledge Burmese Flora, p. 130*)—"Cultivated all over Burma and frequently seen in deserted tongyas, along the borders of forests, around villages, &c." It is indeed significant that in the Great Indian Herbarium, which represents the collections and labours of all past botanists—**Roxburgh, Wallich, Griffith, Gibson, Hooker, Kurz, Clarke, King**, &c., there should not be a specimen marked "wild," if indeed the plant be truly wild in India. **Mr. Talbot** does not say the plant is wild in Kanara, and **Dr. Gibson's** specimens of **C. capsularis** from Bombay, now in the Calcutta Herbarium, have not been sent to the writer, so that they are presumably marked as cultivated. **Mr. Duthie's** specimen alluded to above is undoubtedly the round fruited condition to which the name **capsularis** is given, and it is thus the only specimen the writer has seen that is stated to have been gathered from "what appeared a wild condition." **Roxburgh** has no hesitation in pronouncing the non-jute-yielding species as natives of India. **C. decemangularis** of **Roxburgh** has, by several botanical writers, been reduced to **C. olitorius**, but of his plant **Roxburgh** states that it is a native of Bengal. While describing **C. olitorius**, so as to distinguish it from his **C. decemangularis**, he carefully avoids committing himself to a definite opinion as to

3 JUTE.

its nativity. Edgeworth says of the Banda district, N.-W. Provinces, that this plant is found "in the fields." A special enquiry was, in 1873-74, instituted in Madras into the whole subject of wild or cultivated jute found in that Presidency, and while **C. olitorius** was reported to have been discovered both wild and cultivated, it is expressly stated in the report that **C. capsularis** does not occur in Madras. **DeCandolle**, after enumerating all the countries where the plant is cultivated (*viz.*, the Sunda Islands, Ceylon, India, Southern China, the Philippine Islands, and Southern Asia generally) says: "I am not convinced that the species exists in a truly wild state north of Calcutta, although it may perhaps have spread from cultivation and have sown itself here and there." The writer spent many years in Bengal, and botanised over the greater portion of that Presidency, but he cannot say that he ever came across either **C. capsularis** or **C. olitorius** in what he could regard as a wild or rather indigenous condition. The latter may possibly be wild in some parts of Western India, but grave doubts may be entertained as to either being natives of Bengal,—the province where they are now mainly cultiva ed, and where they exist frequently enough as weeds around the cu tivated jute fields. The suggestion is offered, that, by experimental cultivation, it might be found possible to produce forms of **Corchorus** from some of the truly wild species which would closely approximate to **C. capsularis** and **C. olitorius**. With the imperfect knowledge we possess of this subject, the writer would be much more willing to admit the possibility of some such theory, to account for the cultivated jutes, rather than believe that manifest escapes from recent cultivation are the sole survivals of the wild forms of these plants. The scientific distinction based on the length of the fruit vessel (round in **C. capsularis** and elongated in **C. olitorius**) is, to say the least, scarcely worthy of as much consideration as the peculiarities recognised by the cultivators in distinguishing (within each of these) the various cultivated forms that yield the commercial qualities of the fibre. A similar distinction in the shape and the number of cells of the fruit was made to give origin to certain species of **Brassica**, all of which can be produced from the seeds of any one by careful cultivation.

It is noteworthy that definite Sanskrit names should not exist for these most useful plants, while other plants of far less value have assigned to them names so precise as to distinguish their varieties, to separate their wild from their cultivated forms, and to indicate every possible structural peculiarity. There are neither Arabic nor Persian names for the species of **Corchorus**, known to the people of India, and the greatest uncertainty exists regarding one or two Sanskrit synonyms that have been assigned to the jute-yielding species. Indeed, it seems highly probable that these names are entirely incorrect or rather are referable to other fibre-yielding plants. **DeCandolle** says: "No Sanskrit name for the two cultivated species of **Corchorus** is known." The word *jútá*, in one of its meanings, is at most, the name for a fibre which may or may not have been the modern jute. **Mr. Ram Sunker Sen** gives, however, a very different derivation for the word jute which would remove it altogether from *jútá*. He says that at the silk filatures of Eastern Bengal refuse silk is known as "*jhuta-jhut*," evidently a corruption of the Sanskrit *uchchista*, signifying refuse. This word *jhút* being in constant use among the owners (chiefly Europeans) of silk factories in the districts of Burdwan, Nuddea, Rajshahye, Moorshedabad, Pubna, and Malda, and the fibre of the plant known as *pát* amongst the natives—bearing a strong resemblance to the same—the term *jute* in its softened form came gradually to be applied to *kosta* in dealings and shipments at Calcutta. But, as opposed to this, it may be

3 JUTE.

urged that when Roxburgh was told that the plant grown in the Botanic Garden was jute, there were in all probability no such dealings in the fibre between Calcutta and Eastern Bengal. Besides, Mr. Kerr rejects this derivation of the word, on the ground that jute is in no way a waste, rejected, by-product or remnant, as would be implied by the word *uch-chista*. At the same time Mr. Sen's idea would simply be that it was in appearance like the first few threads drawn from the cocoons—the waste known in Europe as "ort" and which in India is made into *chasam*—but was not itself necessarily a waste, or as Mr. Kerr puts it, "an offal material like ort." It must be admitted that the long golden bands of jute fibre bear a close resemblance to the ribbands of waste silk or *chasam*, and that there are many much more unlikely derivations for words in common use than Mr. Sen's explanation of Jute from *jhut-a-jhut*, the Hindi *jhuttha*, the more so since the fibre is mainly produced in the very districts where the people were familiar with *jhut-a-jhut*. But, on the other hand, the word *jhot* is the only name by which jute is known in Balasore, and *jhont*, *jhot*, are common names for the fibre throughout Orissa. It has been pointed out that the gardeners employed in the Royal Botanic Gardens under Roxburgh were most probably, as at the present day, natives of Orissa, and that, therefore, the name jute given by Roxburgh, the first European writer who used that name, was in all probability a softened form of *jhot*, a word which may be admitted to have come from the Sanskrit *jhuta*, unless we presume Mr. Sen's derivation of the word to have prevailed all over Orissa prior to Dr. Roxburgh's discovery of the plant.

The Sanskrit word *Nádika* is said by Dutt to have been given to C. olitorius and *kálasáka* to C. capsularis, but while Dr. Dutt's work is devoted to the Materia Medica of the Hindus and is compiled from Sanskrit medical works, he only gives the above names in a Glossary at the end, and does not attribute to the plants, to which he says they refer, any properties as known to the Sanskrit writers, while the modern Hindus use the leaves of jute and the species of Corchorus generally, both as food and medicine. Dr. Moodeen Sheriff, a high authority on vernacular names, does not give Sanskrit, Arabic, or Persian names, to the species of Corchorus, nor, indeed, can any of the local names that are in use in the provinces of India (of a restricted or specific character) be exhibited as derived from classical synonyms. *Patta*, a Sanskrit word given to jute by some writers, reappears throughout India in some form or other, being applied first to one fibre and then to another. In its early usage it simply means a "shining fibre," and was most probably originally given to silk, although in the *Mahábháratta*, presents of garments are mentioned as *patta-jam* (*patta*-produced) and also *kita-jam* (insect-produced), thus relieving the word *patta* from being silk. *Patta* also occurs in the Institutes of Manu in such a form as to leave no doubt that it was then applied to a vegetable fibre, probably jute. *Kosha*, if it be the root from which the name used in Eastern Bengal for jute, has been derived, nowhere appears in Sanskrit literature as a name for that fibre, nor indeed for any other fibre, while *Nádiká* refers to the edible property of jute and not to the fibre. Among the early synonyms for *patta* may be mentioned that of *Rája sana*, the large or noble sana, *kakkhata patraka*, "the rough leaved," and *sanni*, the sunn-like—names which would suggest a later introduction than Crotalaria juncea to which *patta* is compared. This idea receives further support from the fact that while *sana* occurs in the most ancient Sanskrit works, *patta* appears in the comparatively recent. In one of the references to *patta*, it is spoken of as the *chimi* (probably a misspelling for China) *pát*, a fact which would point to the cultivated jute plant having come to India from China. Mr. Hem

3 JUTE.

Chunder Kerr reviews all the reports and early books of travel that refer to fibre or to rope-making in India, and finds that in none of these publications does there occur any mention of the word jute until 1796. In several works *pát* is, however, mentioned as a fibre viewed in India as a form of hemp, but which by the home authors was pronounced to be more nearly allied to flax. By the beginning of the present century the word *pát* was completely superseded by jute in all commercial correspondence.

With an array of facts of this kind before us we are almost justified in believing that Jute plant is either a comparatively modern development from some wild stock which was unknown to the Sanskrit writers, or that the cultivation of the plant has been introduced from some other country and most probably subsequent to the date of even the most recent Sanskrit works. If a modern development, we can scarcely admit that the stock from which it was derived could have disappeared, while numerous wild plants closely allied to **Corchorus capsularis** and **C. olitorius** are abundant and truly wild plants, all of which yield good fibres only inferior to jute to an extent easily accountable for by cultivation. The seat of the Indian cultivation of this plant is from the Hooghly district through Eastern Bengal, especially on the islands and lowlying lands of the Meghna and Brahmaputra Rivers. **C. olitorius**, on the other hand, occurs chiefly on the lowlying lands on the western side of the Hooghly river, more especially in the Burdwan district and in Western and Southern India.

Although there are numerous references to *Patta*, *Jútá*, &c., in early Indian writings, enough has been said to show that the greatest caution is necessary in founding too strong convictions that these names allude to the Pát and Jute of the present day, the more so since jute cultivation in every district of Bengal is spoken of by the local authorities as of modern origin, at least in its present form. In one district its introduction is fixed at 1872, in another at 1865, in a third before the date of the British rule, and in a fourth it is put down at 400 years ago. In all districts it is spoken of, however, as a crop regarding which some period could be fixed, while no such language is used with regard to rice, cotton, sunn-hemp, or any other crop of an importance at all comparable with Jute. (*Conf. with* **C. olitorius** *in a further page.*)

FIBRE.

Fibre.—See a further page, and also **Jute.**

MEDICINE.

Medicine.—The leaves dried are used medicinally, being eaten at breakfast-time with rice in cases of dysentery. The cold infusion is also administered as a tonic in dysenteric complaints, fever, and dyspepsia.

OIL.

Oil.—"The seed when fried over the fire yields an oil chiefly used for lighting purposes" (*Ramshunker Sen, Agri. Gaz., 163*).

Corchorus fascicularis, *Lam.; Fl. Br. Ind., I., 398.*

Vern.—*Hirankhori, bhauphali,* BOMB.; *Jangli* or *ban-pát, bilnalita,* BENG.

Dymock points out that the name *bhauphali* must not be confused with the Maratha *bhaphali*, a name given to an umbelliferous plant, and it may here be suggested that the N.-W. P. name *ban-phal* given to **C. olitorius** may have arisen from a misreading of *bhauphali*. The name *bhauphali* or *báphullí* is also given to **C. Antichorus.**

References.—*Roxb., Fl. Ind., Ed. C. B. C., 429; Dymock, Mat. Med. W. Ind., 2nd Ed., 115.*

Botanic Diagnosis.—Capsules small (½-¾ inch) almost cylindrical, very hairy, beak 3-4, splitting with the dehiscence of the capsule. Seeds triangular or diamond shaped, more pointed at the lower end and very similar to those of **C. olitorius** but smaller.

3 JUTE.

Habitat.—A common wild plant throughout the hotter parts of India from the Panjáb to Bengal, and westward to Bombay (common, for example, at Surat). Distributed to Ceylon.

FIBRE.

Fibre.—The fibre extracted from this plant is employed in Sind in the manufacture of ropes.

MEDICINE.

Medicine.—Sakharam Arjun mentions the fact that the whole of this plant is mucilaginous, and states that in Bombay "a watery extract mixed with sugar-candy is taken as a nutritive tonic. It is also given in seminal weakness." Dymock remarks that in Bombay the "whole plant is sold in the shops; it is very mucilaginous and somewhat astringent, and is valued as a restorative." The name *hirankhorí* given to it, means deer's hoof.

Corchorus olitorius, *Linn.; Fl. Br. Ind., 1., 397.*

JEW'S MALLOW.

Vern.—*Pát, koshta* (*bhunjí pát*, according to Drury, and *bhungí*, in *O'Shaughnessy's Beng. Disp.*), *lalita pát, bhunjí-pát, bhungí* or *ban-pát* (according to K. L. De), BENG.; *Singin janascha, koshtá* (according to Benson), HIND.; *Peratti-kirai, punaku cheddy*, TAM.; *Parinta, périnta-kúra*, TEL.; *Ban-pát*, SIND.; *Ban-phal*, in N.-W. P. (Atkinson) and PANJAB (Stewart); *Nádika* (according to Dutt), *patta* (according to Roxb.), and *Sing giká* (according to Ainslie), SANS.

The word *Nálitá* (a corruption of the Sanskrit *Nádiká*) is, correctly speaking, the name for the pot-herb prepared from any Corchorus, the species so used being distinguished by a prefix, thus *ghi-nálitá* (C. capsularis), *tili-nálitá* (C. acutangulus), and *bil-nálitá* (apparently C. Antichorus). *Nálitá* by itself may probably have been the spinach prepared from C. olitorius, the species most generally eaten. *Nálitá* becomes *nutia* in Mymensing, and *narich sag* in Chittagong, thus apparently breaking down Dutt's *narchá* as the Bengali for C. capsularis, and *Nádika* the Sanskrit for C. olitorius. Sir Walter Elliot alludes to this species but makes no mention of C. capsularis, and neither assigns *Jútá* nor *Patta* to Jute.

Ainslie was perhaps the first European writer who assigned to this plant the Hind. name *singgin-janascha*, and while this has been reproduced by several subsequent authors, the word does not appear to be in use in India at the present day, at least not in Hindustan proper. The Sanskrit names given above have already been commented on under C. capsularis. Mr. Hem Chunder Kerr points out that the word *bhunjí* (given by various authors as a Bengali name for this plant) is not employed at the present day. It is derived from the Sanskrit *bhangá* (Cannabis sativa), and thus recalls in a remarkable way Rumphius' name for jute, *gunja* or *gania* (may not *gunny* or *guni* as now applied to jute cloth have come from the same source?). In ever so many ways at all events the early literature of jute is mixed up with that of hemp and sunn-hemp, so much so as to suggest that it *may be an introduced plant, which at first was viewed as a form either of hemp or sunn-hemp.*

References.—*Buchanan-Hamilton's Dinagepore; Ainslie, Mat. Ind., II., 387; Roxb., Fl. Ind., Ed. C.B.C., 429; Griff., Not. Dist., 512; Dals. & Gibs., Bomb. Fl., 25; Drury, U. Pl., 157; Baden Powell, Pb. Prod., 333; Atkinson's Him. Dist., 733; U. C. Dutt, Mat. Med. Hind., 311; Moodeen Sheriff, Supp. Pharm. Ind., 114; Murray, Pl. & Drugs, Sind, 64; Benson, Saidapet Exper. Farm. Man., 63; DeCandolle, Origin Cult. Pl., 132.*

Botanic Diagnosis.—Glabrous, except the upper half of the petiole, and the primary veins on the under surface, where woolly hairs occur; nervules transverse, nearly parallel, pellucid, and anastomosing. Capsule very long and glabrous, beak straight; remains of the flower forming a thick scar. Seeds somewhat triangular, pointed at both extremities, but much more so to the hilum, surface often roughened, so as to appear as if minutely hairy.

3
JUTE.

Habitat.—In the *Flora of British India*, it is stated of this species that it is "indigenous in many parts of India," and is generally distributed by cultivation in all tropical countries. The chief seat of its Indian cultivation is near Kulna in the Burdwan district of Bengal, but it is probably cultivated also in western and southern India; the following botanical writers allude to the plant:—**Dalzell** and **Gibson** say that it is common in Bombay, and **Talbot** (a botanical observer whose opinion must carry considerable weight) remarks: "Abundantly wild about Yellapur." **Dr. Gibson** has left a specimen of this species in the Calcutta Herbarium which was collected in Western India; from the *Herb. Ind. Or. Hooker fil., and Tomson*, there is a sheet of specimens from Mysore and the Carnatic; **Gamble's** No. 15912 is from South India; **Clarke's** No. 23613 from Kangra; and **Duthie's** No. 7121 from Dera Ismail Khan. With the exception of the last mentioned, all the above specimens (from the Calcutta Herbarium) are undoubtedly the form called **C. olitorius**, but they are not stated whether collected from wild, acclimatised, or cultivated plants. **Duthie's** specimen has the seeds of **C. olitorius**, but instead of being glabrous the capsules are hairy along the angles and have a few of the peculiar tufted hairs of **C. trilocularis**, as well as the long narrow capsules of that species. It has also the thick and somewhat linear, coarsely serrated, leaves peculiar to that plant, but the leaves are not only hairy but have a few of the tufted glandular hairs on the under surface as well as on the fruit. **Kurz** gives the habitat of **C. olitorius**, as far as Burma is concerned, as "Ava, Pegu, cultivated and wild in rubbishy places and agrarian lands." **Atkinson** says that it is found in "Dehra Dún," but in this connection it may be added that in the Saharunpur Herbarium, while there are specimens of the allied species, **C. acutangulus**, from various localities in the North-Western Provinces and the Panjáb, there are none of **C. olitorius**. One specimen of **C. acutangulus** is marked as collected at Dehra Dún, and it is probable this may be the **C. olitorius** alluded to by **Atkinson, Stewart**, and other writers on the Flora of Northern India. In the report (to which reference has been made under **C. capsularis**) on jute cultivation in Madras, it is stated that a considerable amount of **C. olitorius** is grown in Ganjám, Godavery, Kistna, and Nellore, but not for its fibre. The Collectors of Ganjám and Godavery say it is wild in their districts. The only district in the southern parts of the Madras Presidency where the plant was discovered was Salem, the Collector having found a specimen on the margin of a field, which **Dr. Bidie** identified as **C. olitorius**. A sample of **C. trilocularis** is, however, in the Saharunpur Herbarium named **C. olitorius**, and this was apparently collected by **Mr. J. S. Gamble** in the Kistna District; it bears the number 12662. The merest possibility of such a mistake existing regarding the Kistna samples reported on above may be admitted as sufficient to throw a doubt on the indigenous character of **C. olitorius** in even the northern districts of Madras. At all events, it is now admitted that the so-called "jute" of Madras commerce is Sunn-hemp and Hibiscus fibre, but not **Corchorus** at all. The Agri.-Horticultural Society of Madras submitted in 1873 a report on the jute cultivation and manufactures of that Presidency, but in the following year wrote and informed Government that they had now discovered that the plant that yielded the so-called jute of their former communication was a species of **Crotalaria** and not of **Corchorus**. **Roxburgh** points out in the *Flora Indica* that there is a wild form of the plant known in Bengal as *ban-pát* or wild *pát* which has reddish stems. In his *Hortus Bengalensis*, he speaks of two varieties of **C. olitorius**, a green form (the *pát*) and a reddish (the *ban-pát*). This opinion is accepted by **Ainslie** and by

3 JUTE.

O'Shaughnessy, both of whom call the green variety **C. olitorius** and the reddish **C. capsularis**. The term *ban* or *jangli pát* is, however, at the present day, applied in Bengal to **C. fascicularis**, a distinct species from either of the above. **Stewart** remarks that **C. olitorius** is found wild in the Panjáb; but he does not give its Panjábí names, while he says it is the *ban-pát* of Bengal, a circumstance that would seem to justify the inference that **Stewart's** wild **C. olitorius** should be corrected into **C. fascicularis**, the more so since that species is undoubtedly wild in the Panjáb, although not alluded to by **Stewart**. (*For another error committed by* **Stewart** *see the remarks under* **C. acutangulus.**) At the same time the writer, on looking over the Saharunpur Herbarium collections found one specimen, apparently correctly named **C. olitorius**, which was discovered by **Dr. Aitchison** (No. 476), and on which the note occurs, "occasional from Thul to Kuram." The Saharanpur Herbarium, as already remarked, does not, however, possess a sample of **Corchorus olitorius** as found in the Panjáb proper.

If, after carefully considering these somewhat conflicting opinions, we still believe that **C. olitorius** is indigenous to India; if, indeed, we accept it as a truly wild form and not a product of cultivation (possibly from **C. acutangulus** and **C. trilocularis**) escaped and assumed a semi-wild condition, then it might almost be safe to believe that it was the parent of all the cultivated forms of jute. In the writer's opinion, however, its claim to being viewed as indigenous rests at present on doubtful evidence, but it may at least be confidently asserted that it is not wild in the districts where it is now or ever has been known to be cultivated for its fibre. Indeed, there is a strong probability that as a cultivated plant **C. capsularis** came to India from China or Cochin-China, and that **C. olitorius** may have been produced in India. Its extensive use as a pot-herb might explain its acclimatisation over so extensive an area as has been indicated. But more can certainly be said in favour of a possible Indian origin for **olitorius** than for **capsularis**. The latter would appear to have been cultivated in China before the date of its having been authentically known to the people of India. It has been grown, for example, in the neighbourhood of Canton for many centuries, and **Roxburgh** says it is there called *Oi moa*. **Mr. Hem Chunder Ker** suggests the strong resemblance of this name to the Sanskrit "au-ma" signifying "flaxen." The Malays call **C. capsularis**, *Rami-tsjima* or Chinese hemp. But in the same way **C. olitorius** has been known to the Egyptians and Syrians for a very long time, their acquaintance with it being possibly prior to the date of the evidence of a positive character, that a knowledge of the properties of the plant was possessed by the inhabitants of India. The Greek Κορχορος was applied to a pot-herb, but in all probability the plant alluded to was not the Corchorus of the present day. Accepting the derivation of the Greek word as implying a drug useful in the treatment of eye diseases, it may be pointed out that no such property is claimed for the species of Corchorus. It is perhaps only a fanciful idea, but this property of a collyrium associated with μαμηρα and μολοχινα with *tita* and *tikta* recalls the properties of **Coptis Teeta** or **Picrorhiza Kurroa** as possibly in some strange way connected with the edible and medicinal properties of Κορχορος. There is no good Hebrew name for jute; the word *malluach* (*Job, XXX., 4, 1520 B.C.*) has been translated mallows, and probably correctly, since in Egypt the mallow is extensively cultivated and used as a pot-herb. At the same time, it is well known that **C. olitorius** has for centuries been cultivated near Aleppo as a pot-herb, hence, says **Rauwolf**, the name *Olus judaicum* which the French have translated *Mauve de Juif*, and the English have rendered as *Jew's*

Mallow. It began apparently to be cultivated in Egypt about the beginning of the Christian era. It is there known by an Arabic name *melokych,* a word which seems in Crete to pass into *maulchia* (Conf. DeCandolle). It will at once be seen that these Arabic names (if indeed they be Arabic) bear no relation to the vernacular synonyms given even by the Muhammadans of India (still less the Hindus) to any form of Corchorus. This fact would point to the Muhammadans not having known it by its Arabic names prior to or during their successive invasions of India, which were continued for a thousand years from the 7th century. In consequence of this long period of Muhammadan influence, India obtained the Persian and Arabic names given to her plants and animals, but there being no names in these languages (in the forms in which they are now preserved in India) for the species of Corchorus, the inference is practically unavoidable that the properties of these plants were not known to the early Indian Muhammadans. To this line of reasoning may be added the further consideration that it was not until the middle of the 18th century that the Europeans then living in India came to hear of the plant. **Roxburgh** about the beginning of the present century was the first author to announce the name Jute as that given to a hempen fibre of great value prepared from either of two species of Corchorus. And, indeed, the paucity of vernacular names for the various forms of Corchorus is perhaps one of the most striking evidences of the knowledge of the properties of these plants being of a comparatively modern date. The reader would do well to compare the names given for **C. capsularis**—the jute plant—with those under **Cocos nucifera**—the cocoa-nut,—or for **Crotalaria juncea**—the sunn-hemp—in order to realize the degree of importance that should be attached to this suggestion and to appreciate the spirit of caution indicated as necessary before too sweeping conclusions are derived from the accidental observations of certain writers who have asserted that both forms of the jute plant are natives of Bengal, because they are plentiful weeds in cultivated situations. (*Conf. with* **C. capsularis.**) 3 JUTE.

Fibre.—See a further page and under **Jute.** FIBRE.

Medicine.—**Ainslie** says that **Dr. Francis Hamilton** (the **Buchanan-Hamilton** of later writers) had brought to him, while in Behar, specimens of this plant as an herb used medicinally by the Hindus. "Fresh or dry after being toasted and reduced to ashes it is mixed with a little honey, and given daily in *petai* (obstructions of the abdominal viscera)." **O'Shaughnessy** remarks, "an infusion of the leaf is much employed as a fever drink among the natives of the Lower Provinces, and **Mr. Twining** mentions the practice with approbation in the second volume of his admirable work on the diseases of Bengal." **Mr. Atkinson** says: "The leaves are emollient and used in infusion as refrigerant in fevers and special diseases. The dried plant toasted and powdered is used in visceral obstructions." MEDICINE.

Dr. K. L. Dé, C.I.E., says: "The dried leaves of this plant are sold in the market. A cold infusion is used as a bitter tonic, and is devoid of any stimulating property. **Mr. Simon** of Assam informs me that it can be safely given to patients recovering from acute dysentery to restore the appetite, and improve the strength. Six grains of the powder, combined with an equal quantity of **Curcuma longa,** has been used, in several instances, with much success, in acute dysentery. It forms a cheap domestic medicine in a Hindu household." **Dr. Bidie** alludes to the dried plant being used in South India as a demulcent.

Food.—Throughout India this plant is more or less cultivated as a pot-herb, although chiefly so in Eastern Bengal. The Santals have a FOOD.

3 JUTE.

peculiar form which may prove an undescribed species; it is known to them as a useful pot-herb under the name of *bir-narcha* (*Rev. A. Campbell*), a name most probably derived from the Bengali *narchá* (**C. capsularis**), hence of some importance historically, since it would indicate that the knowledge of the plant was derived from the Bengalis instead of being anciently possessed by this primitive aboriginal race. **Mr. Atkinson** in his *Economic Products* gives (*Part V.*) a complete list of all the wild or cultivated vegetables, greens, &c., used by the people of the N.-W. Provinces, but makes no mention of any species of Corchorus.

DOMESTIC.

Domestic Uses.—The stalks, after the removal of the fibre, are used for making gun-powder charcoal, and are also employed in the manufacture of baskets, &c.

Corchorus tridens, *Linn.; Fl. Br. Ind., I., 398.*

Botanic Diagnosis.—Much more nearly related to the next species than to **C. acutangulus.** Seed larger and raphe-like cord more distinct than in **C. trilocularis,** capsule with glandular hairs in tufts.

Habitat.—The *Flora of British India* says of this species: "Generally distributed."

FIBRE.

Fibre.—**Murray** specially mentions this species as affording a cordage fibre in Sind.

C. trilocularis, *Linn.; Fl. Br. Ind., I., 397.*

Vern.—*Kurú chunta*, BOMB.; the seeds are in the bazars sold under the name of *Rája-jira*; *Kaunti*, SANS.; *Tandassir*, KAN. (according to **Lisboa**); the seeds are known as *Isbund* in Sind (according to **Murray**).

Reference.—*Dymock, Mat. Med. W. Ind., 2nd Ed., 115.*

Botanic Diagnosis.—Stems, petioles, and under-surfaces of the leaves hairy (as in **C. acutangulus**), but upper surface often almost quite glabrous. Capsule long thin straight angled, beak straight; hairs on the fruit short ascending tufted, 3-6 spreading from a thickened gland which is often persistent on the old fruits. Seeds black, smooth irregularly square on section, obliquely and sharply truncate at both extremities, hilum large with a raphe-like cord thrown from it to the top of the seed crossing one of the angles. The writer would be disposed to unite **C. tridens** and **C. trilocularis,** and bring with these, into a section characterised by the seeds, the species **C. urticæfolius.** He can put no reliance on the presence or absence of a short style or of a spreading stigma, as he has found both these conditions on the same plant. The fruits of the species of Corchorus are more variable than any other part of these plants.

Habitat.—The *Flora of British India* states that this species is met with in the N.-W. Provinces, the Panjáb, Sind, and south to the Nilgiri hills. **Roxburgh,** however, says that it is a native of Bengal, and flowers about the end of the rains, and **Lisboa** that it is found in Gujarát, Sholápur, and other high dry ranges. **Dymock** remarks that it appears along with **C. olitorius,** from which it may be distinguished by its oblong, lanceolate leaves, trilocular capsules, and small seeds.

FIBRE.

Fibre.—"From the fibres good rope is manufactured" (*Murray*).

MEDICINE.

Medicine.—**Dymock** says: "In Bombay the seeds of **C. trilocularis,** which are bitter, are administered in doses of about 80 grains in fever and obstructions of the abdominal viscera. A bitter Corchorus was known to the Greeks. **Theophrastus** says ὀπαροιμιαζόμενος διά τὴν πικρότητα κόρχορος (H. P., 77). **Pliny** (21, 32, and 25, 13) also mentions it as a poor kind of pulse growing wild." **Murray** states that "the plant macerated in water for a few hours yields a mucilage which is prescribed as a

demulcent, and the seeds as a specific in rheumatism." (*Pl. and Drugs, Sind, 65.*)

The *Ulfaz Udwiyeh*, by **Noured-din Mahomed Abdulla Sherazi**, uses the name of *isbund* for a species of what appears to be mustard seed.

3 JUTE.

JUTE.

JUTE.

In connection with the reports of the Calcutta International Exhibition the writer published the greater portion of the facts which will be found in the present account of the fibre obtained from the species of **Corchorus**. In a further volume the commercial aspects of jute will be given (see **JUTE**), while in the following pages an effort is made to present a general and historic sketch of the subject together with certain facts of economic interest connected with the species of **Corchorus**. It may here be stated that the commercial fibre Jute is obtained from either one or both of the following species of **Corchorus**, *vis.*, **C. capsularis**, *Linn.*, grown in Northern, Central, and Eastern Bengal, and **C. olitorius**, *Linn.*, raised in the vicinity of Calcutta. Little or no jute is produced in the other provinces of India, its place being generally taken by **Cannabis sativa**, **Crotalaria juncea**, or **Hibiscus cannabinus**. A futile effort was, however, made to establish in Bombay a trade in **Malachra capitata**. The reader is, therefore, referred to the accounts given of the above mentioned fibre-yielding plants to complete the present article on the history of, and trade in, jute, and the uses of the various species of **Corchorus**. The information contained in the writings of the early authors is often so confused that a definite knowledge of any one of these fibres can only be obtained by a careful study of all.

Comm. and Vern. Names.—Jute, or Jew's Mallow, ENG.; *Jute, mauv des juifs, corde textile*, FR.; *Jute*, GERM.; *Pát*, BENG. **Roxburgh** says that "the Bengalis call it jute," but **Royle** enters into an explanation of the origin of the word, which he makes out to be a corruption of *choti*, the name of a coarse cloth formerly made from this fibre. In Orissa, this cloth was called *jhut, jhóto, jhúto*, from which probably **Roxburgh** derived *Jute*, seeing that the native gardeners generally found in Bengal are inhabitants of Orissa. *Phetcwoon*, BURM.; *Patta, júta*, or *jata*, SANS. **Professor Skeat**, at a meeting of the Cambridge Philosophical Society, gave three meanings to the Sanskrit word *júta*, one of which might be accepted as giving origin to the Orissa names from which **Roxburgh** constructed the form of the word now in commercial use. The plant when used as a pot-herb and dried as a medicine is in Bengal called *Nalita*. The fibre is *Pát or Koshta*, and commercially, *Jute*.

The cloth, which was once largely worn by the poorer classes, although now almost superseded by European goods, is called *Tat*. The coarser cloth made into bags and used for bedding was called *Choti*. The word *gunny* is perhaps derived from "*gun*," a sail; or from "*goni*," a South Indian name for coarse sackcloth, made originally, as it would appear, from *Sunn* not from *Jute*. (See para. 1793 and 1800, also **Crotalaria juncea**.)

References.—*Hem Chunder Kerr's Report on Jute and other Fibres in Bengal, 1877; Babu Ram Comal Sen, Trans. Agri.-Hort. Soc., Vol. II., 91; Royle, Fibrous Plants Ind., 240—252; Col. L. Conway-Gordon's Report on the Jute Traffic in Eastern Bengal, 1885; Report on Indian Fibres by Cross, Beavan, &c., page 35; Spons' Encycl., 940; Roxb., Fl. Ind., Ed. C. B. C., 429; Ainslie, Mat. Ind., ii., 387; Drury, U. Pl., &c., &c., and to the references already given under each of the species of Corchorus.*

HISTORY OF THE JUTE INDUSTRY.

HISTORY.

The history of the modern Jute industry is exceedingly interesting and intimately associated with the British rule in India. There can be no doubt that jute was known to the people of India from compa-

3 HISTORY.

ratively remote periods, but, as indicated under **C. capsularis** and **C. olitorius**, from the confusion which existed down to the present century in the words *sunn*, *pat* or *patta*, *bhanga*, and *hemp*, &c., names applied to certain Indian fibres, it is difficult to determine for certain many of the fibre-yielding plants referred to by ancient writers. The probability is that *sunn-hemp* (the fibre of **Crotalaria juncea**) was better and earlier known to the ancient Hindus than *jute*, and that the true hemp (**Cannabis sativa**) was known to them, if not brought to India by their invading and conquering ancestors. It is almost safe to assume that in very remote times *sunni*, *patta*, and *bhangi* were synonymous and generic terms for fibre and coarse cloth, without much regard to the plant from which the fibre was obtained. If so, about the beginning of the present century, the word *pat* became fixed and associated with the fibre of **Corchorus olitorius** and **C. capsularis**. Prior to that date the Government returns of exports from India mention *hemp fibre*; this must have been either *sunn* or *jute*, since the true hemp fibre has not been cultivated for centuries at least, and modern experiments have shown that the plant is not capable of cultivation as a source of fibre in the plains of India.

With the advance of civilization came an increased demand for cloth, at first as a luxury, and latterly as a necessity. Jute probably met this demand, and, indeed, the poorer people, little more than half a century ago, were largely clad in jute cloth of home manufacture, such as, at the present day, is used by the aboriginal tribes. The increased facilities for the importation of cheap European piece-goods checked, however, the development of this indigenous industry; but with the rapid progress in every other branch of enterprise, there opened up a foreign trade in jute which the agriculturalist found remunerative. The resources of the rich plains of India, Burma, and China, and latterly of America, Australia, and Egypt, were, by the British mercantile fleet, made available for the supply of grain. Bags were required for this trade, and thousands of rough gunnies were greedily bought up. The high price obtained was a powerful incentive to increased activity, and thus the gunny-bag trade rapidly became a recognised part of the Bengal peasant's work. By and by, however, European machinery began to compete with manual labour, and in due time it gained the day. Jute was exported to Europe for cordage, and ultimately for the manufacture of the bags required in the grain trade. The first commercial mention of the word "jute" is in the customs returns of the exports for 1828, when 364 cwt. were sent to Europe. Soon the agriculturist found that his time would be more profitably spent in preparing an extra quantity of fibre, than in manufacturing bags to compete with steam and mechanical appliances; the preparation of fibre speedily outstripped the demand for home manufacture, and a large export trade was established in raw jute to feed the Scotch mills. Thus transferred from its original home, the gunny trade took a new start in Dundee, and down to the year 1854 little or no effort was made to improve the Indian manufacture by the application of European machinery. In that year, however, the "Ishera Yarn Mills Company" was established at Ishera near Serampore by Mr. George Ackland, a large owner of coffee plantations in Ceylon, and non-official member of the Legislative Council of that Island: these mills were afterwards called the "Ishera Company, Limited," and are now known as the "Wellington Mills." Three years later (1857) the "Borneo Company, Limited," a Company originally established to exploit the Island of Borneo, founded the mills now known as the "Baranagore Jute Mills." In 1863-64 the Gouripore Jute Factory came into existence. Following these factories sprang up rapidly in every direction around Calcutta. In the Trade Returns for

1869-70 the exportation of manufactured jute was 6,441,863 gunny bags manufactured by power and hand-looms, and brought into competition with the Dundee bags. This trade developed steadily, and in 1879-80, ten years later, over 55,908,000 gunnies were exported from India. The relative importance of the export trade in raw jute, as compared with the exports in manufactured jute of all kinds, may be seen by a careful examination of the tables (given in another volume), but the result may be summarised by saying that in 1886-87 the exports of raw jute amounted to £4,869,814, whereas for the same year the entire exports from India of power and hand-loom jute manufactures amounted to only £1,149,296. This is of course a comparison between the total exports of raw jute and a portion of the Indian manufactures. In a further page the relative amount of Indian manufactured jute exported as such and the amount used up locally or devoted to the export trade in grain will be found. But speaking purely of India's foreign trade in jute and jute manufactures it would seem that even with 24 large European factories at work in India, and the hand-looms which still survive, scattered over the country, her raw jute interests are four times as valuable to India as her manufactures. A comparison between the exports of Indian "power-loom" as compared with "hand-loom" manufactures will still further show the extent to which the jute manufactures have passed out of the hands of the Indian peasants, who alone, little more than 40 years ago, met the demand for gunny bags. This is seen very clearly when the above figures are compared with the exports of 1850-51. At that time the value of the gunnies exported was greater than that of the raw jute,—the former being £215,978, the latter, £197,071. There were no European factories in India in 1850, so that the market was supplied by the Indian peasant's hand-loom. Steadily the exports increased, the demand for gunnies calling into existence the Dundee mills, and soon after the Indian factories. Nothing could demonstrate the development of the jute trade more than a careful examination of the exports of raw jute and manufactured jute from 1854 to 1887. During that period 24 factories, larger than the average jute factories of Europe, have come into existence, and have gradually commenced to pour their manufactures into the market, largely, if not entirely, meeting the home (Indian) consumption. While this has been taking place, the foreign exports of raw jute have continued to increase uninterruptedly, each year exceeding the preceding, and apparently quite unaffected by the powerful Indian competition with the Dundee and other foreign manufactures.

3 HISTORY.

CULTIVATION AND PREPARATION OF THE FIBRE.

CULTIVATION. Area.

AREA AND EXTENT OF JUTE CULTIVATION.—Jute is largely cultivated in the northern and eastern districts of Bengal and to a smaller extent in the central tracts of the province. In Assam it is grown in Goalpara. The area under the crop in these two provinces during 1886-87 has been approximately estimated at 1⅓ million acres and the outturn at 20 million maunds. Of this area Assam has from 15,000 to 16,000 acres, with a production of 237,000 maunds of fibre. It has been ascertained that more than half the annual yield of fibre is exported to foreign countries and mainly to Great Britain and the United States of America, the proportion respectively to these countries being 73 to 17 per cent. of the total despatches from India.

The following extract from the jute forecast issued by the Agricultural Department of Bengal for 1887 shows the chief districts where the crop is grown and the approximate areas under it, the latter being in acres:—Mymensingh 250,000, Dacca 170,000, Rungpore 162,000, Pubna 150,000,

3 JUTE. CULTIVATION.

Tipperah 117,000, Furreedpore 85,000, Rajshahye 45,000, 24-Pargánas 44,000, Dinagepore 40,000, Bogra 34,000, Nuddea 30,000, Jessore 30,000, Khoolna 30,000, Purneah 24,000, Hooghly 19,000, Goalpara 15,000.

In other provinces, jute, though occasionally cultivated, is rarely so on account of its fibre, but to a limited extent the wild, acclimatised or cultivated jutes are resorted to for the supply of the fibre used locally. In various official and public reports reference is made to Madras jute. In 1873 the Agri.-Horticultural Society of that Presidency submitted a report to Government on certain samples of jute produced in Madras, but in the year following the Society corrected this statement and informed Government that the whole of the Madras so-called jute was Sunn-hemp. It would thus appear that the jute mill now working in Madras draws its supply of fibre from Bengal, or uses up a certain amount of Sunn-hemp or Hibiscus fibre in the preparation of bags and cloth which it issues. In the Madras Manual (*Vol. I., 361*), it is stated that a portion of the jute used by **Messrs. Arbuthnot & Co.** is produced locally, "but it is hoped that before long the supply will be drawn entirely from the district." Recent experiments have, however, been made in order to discover whether the true jute plant could be profitably grown in Southern India. **Mr. Benson** (in his *Saidapet Experimental Farm Manual and Guide, page 63*), gives the result, arriving at the conclusion that, unless some parts of the Northern Division be more suitable, jute cannot be grown in Madras.

Impossible in Madras.

So in a like manner it has been tried in Bombay and Burma, with apparently the final verdict that, in these provinces, it cannot be produced at a price to compete with Bengal. The plant can be grown most successfully in Burma, but the cost of labour has proved fatal to any idea of an extensive commercial industry. In 1872-73 **Mr. Hem Chunder Kerr** estimated that there were one million acres under jute in Bengal and Assam, distributed over 37 million acres of country, and that should the demand be doubled, the production of that amount would absorb only one-eighteenth part of the available and suitable land. The estimate given above for 1887 shows a considerable increase, but it must be added that, as the areas under the various Bengal crops have not, as yet, been surveyed, little absolute reliance can be put on these returns. Forecasts of the jute crop must, therefore, assume the form of prognostications as to reputed extension or contraction from previous years without conveying any definite idea of the normal area. Such forecasts can, however, receive confirmation from the returns of imports of jute into Calcutta and Chittagong.

Actual area.

Allowing a percentage for local consumption, the area which was under each year's crop during past years may be arrived at by dividing the total maundage* imports by 15, that being the average yield of fibre per acre. Thus the total imports of jute into Calcutta and Chittagong were in 1884-85, 1,51,15,940 maunds, Assam having furnished of that 1,85,518 maunds. Deducting the latter and adding 25 per cent. for local consumption the Bengal production would in that year have been 1,86,63,028 maunds (or 13,330,734 cwt.) We thus arrive at the area as 1,233,913 acres. Upon the same line of reasoning the annual average for the years 1880 to 1884 would have been 1,120,160 acres, and for the period from 1876 to 1880, 861,671 acres. The year 1876 was the first in which the imports of jute into Calcutta were carefully recorded, and the above figures may therefore be accepted as indicating the expansion of the area under jute in Bengal. As confirmatory of this general conclusion, based on the pub-

* An effort has been made to correct returns in maunds into cwt. as being more likely to be understood by European readers; but where this has not been done, the result may be arrived at by the following simple rule: maunds × ⅘ = cwt.

lished figures of imports into Calcutta and Chittagong, it may be here added that **Mr. Finucane** (Director of Land Records and Agriculture in Bengal), in his report of 1886, reviews the figures furnished him by an influential jute merchant, **Mr. Field Wilson** of Naraingunge. He says: "This estimate gives the number of bales of raw jute of 400lb each exported year by year since 1877-78, to which **Mr. Wilson** adds the quantity estimated to have been consumed by the jute mills in Bengal; but the estimate does not apparently take into account the local consumption of the jute in the interior. Making allowance for this omission, **Mr. Field Wilson's** figures, *though it will be observed they are not based on the Custom House returns, nor on the returns of import traffic registration stations, yet closely accord with the estimates above given, and afford confirmation of their substantial accuracy.*" The writer is responsible for the italics in the above quotation. It is desirable to draw attention to the fact that the record of the jute trade preserved by merchants bears a close approximation to that tabulated by Government from the very extensive and complicated returns of road, river, and railway traffic, the concentration in the ultimate centre thus being seen to preserve a distinct relation to the far-reaching ramifications of the stream of supply. But **Mr. Finucane** concludes his review of **Mr. Wilson's** figures as follows:—"If the annual average of the eight years ending 1884-85 be taken into consideration, the difference between the two sets of figures is not considerable, the estimate worked out in this office from the data above described being only 3·97 per cent. less than that of **Mr. Wilson.**"

3 CULTIVATION.

Soil.—Jute seems to be capable of cultivation on almost any kind of soil. It is least successful and almost unprofitable, however, upon laterite and open gravelly soils, and most productive upon a loamy soil, or rich clay and sand. The finest qualities are grown upon the higher lands (*suna*) in the vicinity of the homestead upon which the *aus* paddy, pulses, and tobacco generally form the rotation. The coarser and larger qualities are grown chiefly upon (*sali* lands), *i.e.*, the churs or mud banks and islands formed by the rivers; and, indeed, these qualities may also be found upon submerged lands, and may be said to luxuriate in the salt-impregnated soil of the Sunderbans.

Soil.

Climate.—A hot, damp climate, in which there is not too much actual rain, especially in the early part of the season, is the most advantageous; in exceptionally dry seasons one frequently finds crops standing through the cold season which the cultivator did not regard as worth cutting down.

Climate.

Preparation of Soil.—It may be stated that, when the crop is to be raised on low lands, where there is danger of early flooding, ploughing commences earlier than upon the higher lands. The more clay in the soil, the more frequently it is ploughed before sowing. The preparation thus commences in November or December, or not till February or March; the soil is generally ploughed from four to six times; the clods are broken and pulverised; and at the final ploughing the weeds are collected, dried, and burned.

Preparation of Soil.

Seed.—No special attention is paid to the selection of good seeds, nor do the cultivators buy and sell their seeds. In the corner of the field a few plants are left to ripen into seed, and these are, next year, sown broadcast. The sowings, according to the position and nature of the soil, commence about the middle of March and extend to the end of June.

Seed.

Harvest.—The time for reaping the crop depends entirely upon the date of sowing; the season commences, with the earliest crop, about the end of June, and extends to the beginning of October.

Harvest.

3 CULTIVATION.

The crop is considered to be in season whenever the flowers appear; and past season, with the fruits. The fibre from plants that have not flowered is weaker than from those in fruit; the latter is coarser and wanting in gloss, though stronger. It is late reaping that is chiefly accountable for the coarse fibre found in the market.

Crop

Crop.—The average crop of fibre per acre is a little over 15 maunds, but the yield varies considerably, being as high as 30 to 36 in some districts and as low as 3, 6, or 9 in others, and it is also very dependent upon the season. In the experiments performed at the Saidapet farm, Madras, the yield was 599lb of fibre per acre if reaped close to the ground, and 703lb if pulled up by the root—less than a half of the average yield in Bengal.

Retting.

Separation of Fibre by Retting.—At present, as practised by the natives, the fibre is separated from the stems by a process of retting in pools of stagnant water. In some districts the crop is stacked in bundles for two or three days, to give time for the decay of the leaves, which are said to discolour the fibre in the retting process; in others the bundles are carried off and at once thrown into the water. There is some ground for thinking that, if the drying of the leaves by stacking does not prevent the discoloration of the fibre, the fibre itself is likely to be benefited by the process, since it is found to separate more readily from the stems, and is thereby saved from the danger of rotting from over-maceration. In some districts the bundles of jute stems are submerged in rivers, but the common practice seems to be in favour of tanks or road-side stagnant pools. The period of retting depends upon the nature of the water, the kind of fibre, and condition of the atmosphere. It varies from two to twenty-five days. The operator has therefore to visit the tank daily, and ascertain, by means of his nail, if the fibre has begun to separate from the stem. This period must not be exceeded, otherwise the fibre becomes rotten and almost useless for commercial purposes. The bundles are made to sink in the water by placing on the top of them sods and mud. When the proper stage has been reached, the retting is rapidly completed. The cultivator, standing up to the waist in the fœtid water, proceeds "to remove small portions of the bark from the ends next the roots, and, grasping them together, he strips off the whole with a little management from end to end without breaking either stem or fibre. Having brought a certain quantity into this half-prepared state, he next proceeds to wash off; this is done by taking a large handful; swinging it round his head, he dashes it repeatedly against the surface of the water and draws it through towards him, so as to wash off the impurities; then, with a dexterous throw, he spreads it out on the surface of the water and carefully picks off all remaining black spots. It is now wrung out so as to remove as much water as possible, and then hung up on lines prepared on the spot, to dry in the sun" (*Mr. Henley, in Royle's Fibrous Plants, 248*).

Extraction by Machinery.

Extraction of Fibre by means of Machinery.—There seems little doubt but that the retting weakens the fibre very considerably. Could a simple mechanical contrivance be invented for the purpose of extracting the dry jute fibre, and sold so cheaply that it might be procured even by the poorer cultivators, new and at present undreamt-of industries might spring into existence. It is to be feared, however, that machinery will, for some time to come, be beyond the means of the cultivator, and that the principal improvement may be looked for in the application of natural, mineral, or chemical appliances somewhat on the lines of the Ekman Patent process for the separation of the fibre. A machine deserves attention which is known as Garwood's Patent: it does no more than separate the bark from the stem, and the fresher the stem, the more easily is the bark separated.

3

Mr. W. Cogswell, however, who is an undoubted authority on all questions connected with jute, expressed in December 1881 his opinion that a softer fibre was obtained by the old process (*vide A. H. Society's Proceedings, December 1881*).

PROPERTIES OF JUTE FIBRE.

PROPERTIES OF JUTE.

Chemical and Microscopic.—"The fibre, as found in commerce, consists of the fibre-bundles separated from the cortical parenchyma. The *bundles* contain 6 to 20 fibres. The fibres are firmly coherent in the bundle, the cohesion taking the form of fusion of contiguous walls, the line of fusion being very apparent. The *ultimate fibres* are of the normal fusiform type, 1·5—3 mm. in length. In section they are seen to be thick-walled and polygonal. *Reactions*, characteristic of the jute-allied group of fibres, are brown with iodine; deep yellow with aniline sulphate; purple with phloroglucol and hydrocloric acid; a strong affinity for the basic colouring matters. *Mercerised fibre—Microscopic features.* Concentrated solutions of the alkalies have a remarkable action on fibres of this group. They resolve the bundles more or less completely, and cause the fibre wall to swell so as to almost obliterate the cavity. The filaments, in addition to being made finer, are much softened in texture, and develop a wavy outline, giving the fibre very much the appearance of wool" (*Cross, Beavan, King, and Watt, Report on Indian Fibres, p. 36*). The chemical analysis, as given in the report just quoted, may be here briefly reviewed. Jute, in point of percentage of cellulose (perhaps the best criterion for judging of the value of a fibre), is about equal with **Urena** 77·7, **Calotropis** 76·5, **Abutilon** 75·0 and **Agave** 75·8, and follows after **Abroma** 80·0, **Rhea** 80·3, **Flax** 81·9, **Sida** 83·1, **Crotalaria** 83·0, **Marsdenia** 88·3 and **Girardinia** (Nilgiri nettle) 89·6. Jute possesses 76·0 per cent., and is thus in point of cellulose about the eighth most valuable fibre in India. It is noteworthy that of the fibres enumerated—**Abutilon, Urena, Abroma, Sida,** and **Jute** are obtained from closely allied plants and yield very similar fibres. But of these jute is the next to the last in point of chemical merit, **Sida** being the first of the series. This is a fact of the greatest importance, when it is added that the experts who examined these fibres at the Colonial and Indian Exhibition pronounced **Sida** by a long way superior to jute, being finer in point of fibre, possessing a better colour and thus more suited for many of the higher textile and new purposes to which jute is being applied. Should it be found possible to produce **Sida** at a price anything like that of jute, a formidable rival to the great Bengal fibre would soon appear in the market.

Mercerised.

Cellulose.

Jute contains 10·3 per cent. of moisture and leaves 1·1 of ash; by hydrolysis or boiling for (*a*) 5 minutes, in a solution of caustic soda (1 per cent. Na_2O), it loses 13·3 and (*b*) for an hour, 18·6. As compared with these results European flax loses (*a*) 14·6 and (*b*) 22·2 and **Sida** (*a*) 6·6 and (*b*) 12·2, while other less valuable fibres lose 50 or 60 per cent. By mercerising, *e.g.*, wetting the fibre with a concentric solution of the alkali (33 per cent. Na_2O), jute loses only 11·0 per cent. As stated above, this has a remarkable effect on the jute and jute-allied fibres, causing the bundles to split up into their ultimate fibres, while at the same time obliterating the cell cavity completely, thus causing the filaments to become much finer and softer in texture. By nitration jute gains in weight, becoming 128, being in this respect inferior to any of its allied fibres, but it is found to contain 47 per cent. of carbon having the highest amount of any recorded Indian fibre; **Sida**, for example, possesses 45·2, flax 43·0, and Bauhinia fibre only 40·7.

Ash.

3 PROPERTIES OF JUTE.

The results of the chemical and microscopic investigation of jute, instituted by **Messrs. Cross, Beavan, and King**, may be briefly stated to be that much more might be made of jute than has as yet been accomplished, especially in the direction of altering chemically its properties and thus adapting it for perfectly new purposes. One sample experimented with was made to resemble tasar-silk so closely that some care was necessary in distinguishing these substances; another looked remarkably like wool.

Strength.

Strength and Industrial Properties.—**Royle** remarks: "Jute is certainly characterised by fineness, silkiness, and facility of spinning; but it is less strong than many other Indian fibres, which are possessed of similar properties with greater strength, as we hope to be able to show among the mallow and other nearly allied tribes of plants." This opinion has been fully confirmed above by the results of **Messrs. Cross** and **Beavan** in their chemical and microscopic examination of jute and the allied jute fibres. Accordingly, at the conferences held in connection with the Colonial and Indian Exhibition, the highest expectations were held out of a formidable rival to jute in the fibre obtained from **Sida rhombifolia**. In the recent report of experiments with Bengal fibres issued by the Agri.-Horticultural Society of India, it is stated that the Society had "arrived at the conclusion that the cultivation of **Hibiscus, Abutilon, Sansiviera**, and **Sida** has no advantage over that of jute." This result must be admitted to be somewhat disheartening, but it should not be forgotten that jute has been cultivated for centuries, that it is in consequence more amenable to the cultivator's necessities and the manufacturer's wants. The question is not, therefore, one as to whether jute or **Sida** is more easily cultivated and gives the better result in point of yield of fibre, but whether the intrinsic superiority of **Sida** fibre would justify its experimental and systematic cultivation until a stock was produced that could be grown as readily and admit of as rapid decortication as is the case with jute. The plant is wild to-day, and it is unfair to compare the yield of fibre from such a plant with results obtained from jute. After careful cultivation for 10 or 20 years it would be fair to compare the ease of cultivation and yield of fibre in **Sida** with that of jute, and during this experimental stage remunerative returns might easily be obtained, since there can scarcely be two opinions as to the superiority of **Sida** over jute for the finer textile purposes. **Roxburgh** found in his comparative tests of the fibres of India that a "dry line" of **Corchorus capsularis** broke with a weight of 164lb and a "wet line" with the same weight, whereas **Corchorus olitorius** gave way with 113 and 125lb respectively, the wet line gaining 11lb in weight. This fact of the superiority of the fibre of **capsularis** over **olitorius** is well known in modern commerce. To compare with these results it may be mentioned that, under the same test, a "dry" and a "wet" line of sunn-hemp broke with 160lb and 209lb, respectively, the latter gaining 31lb in weight. Testing jute in another way by macerating in water for 116 days, white, tanned, and tarred lines, **Roxburgh** found **Corchorus olitorius** white and fresh, to break with 68lb, after maceration, to give way with 40lb; **C. capsularis** 67lb and 50lb. Very little difference was observed in the tanned ropes, but the tarred seemed to preserve their strength considerably; the line fresh and tarred broke with 61lb, and after maceration for 116 days bore a weight of 60lb.

The defect of jute is the difficulty to spin the higher counts, 20 being about the finest made, commercially, and when manufactured the fabric lasts well, so long as it is not submitted to a damp influence, but rots rapidly when damp and exposed to the atmosphere.

PRICE OF CULTIVATION.

3 PRICE OF CULTIVATION.

No trustworthy figures are available of the prime cost to the cultivators of raising and extracting a maund of jute fibre. But the following figures, which have been kindly furnished by a mercantile firm, lead to the rates paid to the growers. Jute landed in Calcutta cost as follows, per maund, in the four years ending 1883 :—

Qualities.		1879-80.	1880-81.	1881-82.	1882-83.
		₹ a. p.	₹ a. p.	₹ a. p.	₹ a. p.
Narainganj	Fine	5 2 9	5 0 3	4 15 10	3 7 6
	Medium	4 9 6	4 6 9	4 3 4	2 15 2
	Common	4 0 9	3 13 7	3 10 4	2 7 6
Serajganj	Fine	5 4 0	5 2 0	5 1 0	3 9 0
	Medium	4 11 0	4 8 0	4 4 0	3 1 0
	Common	4 2 0	3 15 0	3 12 0	2 9 0

The average prices for the last four years were as follows :—

	Bengal.	Assam.
	₹ a. p.	₹ a. p.
1883-84	3 12 0	4 0 0
1884-85	3 4 0	2 13 0
1885-86	3 4 0	3 1 0
1886-87	3 10 0	3 2 0

The charges per maund incurred from the time the jute is purchased from the producer to the time it is landed in Calcutta are approximately as follows :—

	Narainganj.	Serajganj.
	₹ a. p.	₹ a. p.
Freight to Calcutta	0 8 0	0 8 0
Drumming, shipping, &c.	0 2 0	0 2 0
Aratdari	0 2 0	0 2 0
Bepari's profit	0 5 0	0 5 0
TOTAL	1 1 0	1 1 0

Deducting the charges just shown from the cost of the jute landed in Calcutta, will give the rates paid to the grower, thus :—

Qualities.		1879-80.	1880-81.	1881-82.	1882-83.
		₹. a. p.	₹ a. p.	₹ a. p.	₹ a. p.
Narainganj	Fine	4 1 9	3 15 3	3 14 10	2 6 6
	Medium	3 8 6	3 5 9	3 2 4	1 14 2
	Common	2 15 9	2 12 9	2 9 4	1 6 6
Serajganj	Fine	4 3 0	4 1 0	4 0 0	2 8 0
	Medium	3 10 0	3 7 0	3 3 0	2 0 0
	Common	3 1 0	2 14 0	2 11 0	1 8 0

The prime cost to the cultivators must be something lower than the figures shown in this last statement; and assuming that the data fur-

3 PRICE OF CULTIVATION.

nished are near the truth, if not correct, they lead to the following important inferences, *viz.*, (*a*) that the price of jute has declined considerably during the past few years, and (*b*) that while the profits of the middlemen have not varied, those of the growers have fallen proportionately with the fall of prices in Calcutta. The price of jute fluctuates very considerably; a good year induces an indiscriminate extension of the area which must of course be attended the following year by a fall in price, and from heavy losses this has the opposite effect of an undue contraction of the jute area. In 1883-84 the price averaged from R3 to R8 a maund. On the other hand, prices in Dacca fell in 1882-83 to 12 annas a maund, and, in consequence, the cultivators suffered much, although in ordinary years they are the most prosperous people in Bengal, and can often earn as much as 10 to 12 annas a day. Scarcity of rain, at the sowing season, produces a bad crop, and a caterpillar often does great damage. In the forecast for 1887, issued by the Revenue and Agricultural Department, Government of India, the following passage occurs:—"The trade statistics of the year have shown that the importation of raw jute to Calcutta from all sources was practically the same as in the previous year; while the value of the exports from Chittagong was twenty-seven lakhs more than that of the previous year. It thus appears that the crop was a larger one than that of the previous year. Owing, however, to the lowness of exchange, and to a brisker demand in Europe, prices were on an average 15·4 per cent. higher than in the preceding year.

"For this reason a larger area than usual has been sown this season, save in limited tracts which had suffered from floods in the two previous years. The prospects of the crop were generally excellent to the end of May, when the young plants were seriously damaged by floods which accompanied the cyclone, especially in the districts of Rungpore, Rajshahye, Dinagepore, Bogra, Julpigoree, and parts of Hooghly. These localities, however, excepting Rungpore, are not of first-rate importance as jute-growing districts.

"On the whole, so far as can be judged at present, it may be said that the area sown this year is about 10 per cent. above that of last year; and, taking into consideration the facts that the area sown is above the normal, and that the deficient outturn caused by floods in some districts will be counterbalanced by the bumper yield in others, it may be expected that the total outturn will be a full average. Much will, however, depend on the distribution of rainfall in the latter half of July and beginning of August."

The following table, extracted from Mr. Finucane's Report (to which frequent reference has been made), shows the average wholesale price of jute per maund since 1876, and at the same time gives a key to the valuations returned by the Custom House:—

	Average wholesale price in 12 selected districts in Bengal.			Average declared value as per Custom House Returns.		
	R	*a.*	*p.*	*R*	*a.*	*p.*
1876-77	3	0	0	4	4	0
1877-78	3	0	0	4	12	0
1878-79	4	0	0	4	10	0
1879-80	4	10	6	4	13	0
1880-81	4	8	0	4	14	0
1881-82	4	8	0	4	14	0
1882-83	3	8	0	4	1	0
1883-84	3	12	0	4	12	0
1884-85	3	4	0	4	1	0

COMMERCIAL VARIETIES.

3 COMMERCIAL VARIETIES.

There are several well-known commercial VARIETIES of jute fibre, of which the following, arranged in the order of their commercial importance, may be mentioned: *Uttariyá, Deswál, Desi, Deorá, Serajganji, Narainganji, Bákrabadi, Bhatial, Karimganji, Mirganji,* and *Jungipuri.*

For convenience of reference we shall discuss these in alphabetical order, those of importance being marked *.

1. **Bakrabadi.**—A beautiful soft fibre, one of the finest qualities from the Dacca district, being raised on the *churs* of the Megna river.
2. **Bhatial.**—A coarse strong fibre, chiefly exported to Europe for rope manufacture. It is grown on *churs* and obtained from the south of Narainganj; hence the name, from *bhati*, tidal.
3. * **Deora** (in commerce *Dowrah*).—A strong useful fibre, used chiefly in rope manufacture. It derives its name from a village near Faridpur, where there was formerly a large mart for this variety of jute. The name is given to all the jute from Backerganj and Faridpur.
4. * **Desi** (in commerce *Daissee*).—This is a useful and good fibre, largely used for gunnies; it is long, soft, and fine, but it has a bad colour and is pronounced "fuzzy." It is produced in the districts around Calcutta, such as Hugli, Burdwan, Jessore, and the 24-Parganas.
5. * **Deswal.**—A fine bright-coloured fibre, much admired on account of its strength. After the *Uttariyá* this is, commercially, the most important variety. It comes from the neighbourhood of Serajganj, and is said to consist of two kinds or sub-varieties:—
   (*a*) Bilan Deswál, or fibre from the crop grown over *bhíls* or marshes.
   (*b*) Charna Deswál, or fibre from the crop grown on *churs*.
6. **Jangipuri.**—A poor fibre, short, weak, and more suited for paper manufacture than for spinning. It comes from the Pubna district.
7. **Karimganji.**—A fairly good fibre, very long, and of good colour. It comes from the Mymensingh district, taking its name from a small village.
8. **Mirganji.**—Generally an inferior fibre; the worst kind coming from Mirganj, a village on the Teesta. The fibre generally comes from the Rungpore district.
9. * **Narainganji** (in commerce *Naraingunge*).—This is an excellent fibre for spinning, being long and soft. It comes from the Dacca district, and is exported to Calcutta from the Narainganj marts.
10. * **Serajganji** (in commerce *Serajgunge*).—Produced in the Pubna and Mymensingh districts.
11. ** **Uttariya.**—This is regarded as the finest variety; it is long, has a brilliant colour, is strong and easily spun, but it is not up to *Desi* or *Deswál* in softness. It comes into the market in November. It receives its name on account of its coming from the northern portions of Serajganj and that neighbourhood. The following are the localities from which it is obtained: Rungpore, Goalpara, Bogra, parts of Mymensingh, Kuch Behar, and Julpaiguri.

These 11 qualities, and others of minor importance, are in commerce generally grouped under four leading classes represented by the *Serajganj, Narainganj, Desi,* and *Deora*; and these, again, are classed as "Fine," "Medium," and "Common," according to the qualities of the fibres. Mr. James Duffus, in a letter addressed to the writer, says of this

3 COMMERCIAL VARIETIES.

subject: "Every small mart in Eastern Bengal has a jute of its own, quite as worthy of mention as many of the minor forms alluded to above." This remark has an interest beyond that of commerce, for we must either infer that this extensive series of qualities of fibre indicates distinct forms of the plant or is due to methods of cultivation and cleaning of the fibre. If the former, this fact might be accepted as an indication of long cultivation or even of extensive hybridisation.

FOREIGN TRADE IN JUTE AND JUTE MANUFACTURES.

FOREIGN TRADE.

For full particulars of this trade up to date see **JUTE** in another volume. The present article is intended more as a historic sketch of the jute industry in which an attempt is made to give the main facts of the cultivation of the plant, and of the Indian manufactures.

INTERNAL TRADE.

INTERNAL AND COASTING TRADE.

A good deal of the details of this trade will be discussed under the headings "Home Consumption of Raw Jute" and "Home Consumption of Jute Manufactures." It may not be out of place here to indicate very briefly the relative share participated in the trade by the various existing modes of conveyance. In a special Report on this subject **Colonel L. Conway-Gordon, C.I.E.**, gives the figures from 1880 to 1885, but he refers apparently to raw jute only. During the last year dealt with by him he states that "the amounts of jute exported by sea from Calcutta and Chittagong" were 7,158,868 cwt., and 1,033,733 cwt., * respectively, the latter port thus taking 12·6 per cent. of the total. This would give the foreign exports as 8,192,601 cwt., whereas in the statement of the Trade of British India for that year the foreign exports were put down at 8,368,686 cwt. and the coasting trade at 1,267,034 cwt., making a total of jute shipments from Indian ports of 9,635,720 cwt. **Colonel Conway-Gordon** gives the total imports into Calcutta as 9,392,813 cwt., of which 3,579,062 cwt. were conveyed by native boats; 1,969,237 cwt. by steamers; 3,482,522 cwt. by the Eastern Bengal Railway; 148 cwt. by the South Eastern State Railway; 356,496 cwt. by road; and 5,348 cwt. by sea. Thus the COUNTRY BOATS head the list, carrying to the sea-board 38·1 per cent. of the total jute supply—the EASTERN BENGAL RAILWAY carrying 37·0 per cent., and the INLAND STEAMERS only 20·9 per cent. The bulk of the BOAT TRAFFIC comes from Serajganj on the Bhramaputra, *viz.*, 894,920 cwt., Pubna sends 302,413 cwt., Nassirabad (in Mymensingh) 298,736 cwt., Madaripore 281,729 cwt., and Narainganj 223,889 cwt. The STEAMERS draw the bulk of their traffic, 1,169,656 cwt., from Narainganj and from Serajganj 602,468 cwt., while the RAILWAY traffic is mostly from Goalundo, represented by 1,300,580 cwt., from Pangsa 242,082 cwt. and from Kooshtea 219,763 cwt.

These figures give a fair conception of the local trade in jute, and from the large share still carried by native craft, an additional proof may be obtained of the value of the jute crop to the people of India. Were it possible to estimate the number of people who make it an important part of their duty to either cultivate, clean, buy, or sell the fibre, and were that number to be added to those employed in conveying it from the fields to the mills, it would be seen that jute is of importance to a far larger number of persons than to the 50,000 who find daily employment in the

* For the purpose of allowing of comparison with the returns of foreign trade, **Colonel Conway-Gordon's** figures of maunds have been converted into cwt.

European factories. But even this estimate would leave out of all consideration the indigenous hand-looms that are still able to compete with steam in the production of jute cloth, bags, and cordage.

3 HOME MARKET.

RAW JUTE.

EXPORTATION AND HOME CONSUMPTION.

EXPORTS.

The following abstract of the EXPORTS OF RAW JUTE FROM CALCUTTA will be found interesting, as showing the steady and constant increase and development of the jute trade. The mean exportations for each period of five years, during the 55 years commencing with 1828, will be seen to have, in round numbers, almost doubled those of the preceding period. It should be carefully noted, however, that these figures represent but a portion of the jute industry,—namely, the exports :—

Up to	Average of five years, in cwt.
1832-33	11,800
1837-38	67,483
1842-43	117,047
1847-48	234,055
1852-53	439,850
1857-58	710,826
1862-63	969,724
1867-68	2,628,110
1872-73	4,858,162
1877-78	5,362,267
1882-83	7,274,000

The foreign exports of raw jute were, in 1882-83, 10,348,909 cwt. valued at ₹5,84,69,259, since which they have declined considerably, being in 1886-87 only 8,306,708 cwt. valued at ₹4,86,98,146. The exports of 1882-83 were the highest on record.

The rapid, yet constant, increase in the jute trade, which the above figures show, from 364 cwt. in 1828 to 10,348,909 cwt. in 1882-83 representing an increase in value from ₹620 to ₹5,84,69,259 in the short period of 55 years (*e.g.*, from £62 to £5,846,925 for exported raw jute alone) speaks volumes for the noble fleet of merchant vessels trading with our Indian ports. **Mr. Hem Chunder Kerr**, in his valuable *Report on the Cultivation of, and Trade in, Jute in Bengal*, has laid much stress upon the Russian war in 1854-55 as a cause of the development of the jute trade of India. It doubtless was a cause, but perhaps only an insignificant one as compared with the demand for a cheap fibre when combined with the internal administrative reforms and the engineering enterprise which, by railway, road, and canal, brought the resources of India into the field of European commerce.

The figures of Indian trade show that the exportation of jute steadily increased from 1,092,668 cwt. in 1860-61, to 3,754,083 cwt. in 1870-71; that in 1871-72, it suddenly rose to 6,133,813 cwt., and during the past 5 years has preserved an average of about 7,274,000 cwt.

In 1882-83 Indian commercial men calculated that on an average Scotland consumed over 18,400 bales (73,600 cwt.) a week. Of these **Messrs. Cox Brothers** take 2,200; **Messrs. Gilroy & Sons**, 750; **Messrs. Malcolm, Ogilvie, & Co.**, 650; **Mr. John Sharp**, 700. In England the weekly consumption is over 1,860 bales, the largest consumers being the **Barrow Company**, 600. In Ireland the total weekly

3 EXPORTS.

consumption is about 730 bales, the largest firm consuming under 300 bales a week. Thus Great Britain requires over 21,000 bales or 84,000 cwt. a week, or 4,200,000 cwt. a year to keep her existing jute factories employed. These figures, when compared with the hand-loom consumption in Bengal, show how completely the gunny trade has passed out of the hands of the Indian peasant. The entire hand-loom consumption of jute in Bengal has been returned as 2,23,000 maunds a year, but allowing 50,000 maunds more to cover imperfections, this would give an annual consumption of 195,000 cwt. The Scotch power-looms alone consume 73,600 cwt. a week, or 3,710,000 cwt. a year. Although in some respects this estimate has been disturbed, it is relatively correct for the present year 1887-88.

France requires 4,000 bales a week, its largest consumer, Saint Freres, requiring 700 bales; Germany requires 2,170 a week, of which the Brunswick Jute Spinning Company consume 770 bales; Belgium requires 845 bales a week; Austria, 580; Spain, 250; Holland, 400; Norway, 100. Taking annual figures for the whole of Europe it is found that Great Britain and the Continent of Europe require 1,800,000 bales a year, or 6,428,580 cwt. It may be here stated that as merchants adopt the calendar year, and Government the financial, *e.g.*, from April to March, considerable difficulty has been experienced in comparing the Government Statistical Tables of Exports with those kindly supplied by one or two well known jute firms in Calcutta.

Comparing with the above figures the 22 Indian factories at work in India in 1882-83, which on an average consumed each 500 bales per week, or 600,000 bales a year, equivalent to 2,142,948 cwt., it would appear that to keep these factories working, about 8,571,428 cwt. of raw jute were required; and adding to this amount the quantity annually consumed by America, Australia, and other foreign countries, *viz.*, 600,000 bales, or 2,142,498 cwt., not included in the above calculation, the annual consumption was little short of 3,000,000 bales, or 10,714,476 cwt. These were the estimates framed for 1882-83, but in an early page it has been stated that this year's production is probably close on 20 million maunds, thus showing a very considerable expansion, although the exports of raw jute have declined somewhat during the past five years.

Annual Capital.

Looking at the exportation of raw jute, of manufactured jute, and the home (Indian) consumption known to our commercial men, the statement that the jute trade is at least represented at the present date by an annual consumption of over 15,000,000 cwt. of raw jute does not seem to be far from correct. This is roughly equivalent to an annual turn over of capital equal to about 12—14 millions of pounds sterling as compared with the exports in 1828 of £62.

MANUFACTURES.

THE MANUFACTURES OF JUTE AND THEIR EXPORTATION FROM INDIA.

In the vicinity of Calcutta, since 1857, 22 jute factories have sprung up in rapid succession, with one (a small one) at Vizagapatam, and another at Cawnpore, where it commenced work in 1887. A mill was started also in Bombay in 1885, but in the following year it was removed to Calcutta. The nominal capital of the mills worked by Joint Stock Companies is stated in the returns at 285 lakhs, which, at the conventional exchange of 10 rupees to the pound sterling, would be £2,850,000. The others are private factories, but their capital may be put down at 30 to 40 lakhs of rupees. These 24 factories have 7,164 looms and 135,593 spin-

dles, and they give employment to 29,660 men, 11,198 women, 5,113 young persons, and 3,044 children. The Madras private jute company employs about 878 persons. Thus, up to the present date, there are in all India 24 Jute factories, which give employment to 49,015 persons and use up 2,869,088 cwt. of jute. They are almost exclusively employed in the gunny bag or cloth trade, three only doing a small business in cordage, floor cloth, or other manufactures. 3 MANUFACTURES.

In 1879 there were in England 12 factories, in Scotland 99, in Ireland 6, in all 117 factories, with 212,676 single and 7,492 double spindles, and 11,288 looms, giving employment in all to 36,354 persons. In India there are only 24 factories, but these employ 49,015 persons.

It is difficult to make a reliable comparison without the details of every individual factory. Judging from the published statistics of jute factories in Scotland during the year 1879, and comparing a fixed number of these with the Indian factories for the same year, we may, however, conclude that the Indian mill workman was inferior to the Scotch workman in the ratio of 3 to 7. That is to say, it requires 7 persons to work one loom in an Indian factory, against 3 workmen in a Scotch factory. This conclusion is arrived at by dividing the total number of persons employed in a factory by the number of its looms, and obtaining the average for all Scotch factories and the average for all Indian factories. Of course this calculation is open to the error of the Indian and English factories not manufacturing the same class of goods; but relatively it may be accepted as giving some sort of comparison.

Foreign Trade in Manufactures.

Foreign Trade in Manufactures.

Prior to 1857 the exports of Jute manufactures from India represented hand-loom fabrics. In 1850 these were valued at £215,978, whereas the trade in raw jute was only £197,071. Fifteen years later the manufactured jute, exported to foreign countries, was valued at R18,27,983 (£182,798) and the raw jute at R75,06,690 (£750,669). In 1870-71 the exports were of manufactured jute R34,24,249 (£342,424) worth and of raw jute R2,57,75,526 (£257,755). But the revival in the exports of manufactured jute indicated by these figures, as also the partial decline of the foreign raw jute trade, was at once the death of the old hand-loom industry and the birth of the new power-loom. Ten years later (1880-81) the total exports of manufactured jute were valued at R1,13,06,716 (£1,130,671), of which the hand-looms produced R2,69,553 (£26,955), and last year they were valued at R1,15,18,577, (£1,151,857), of which the hand-looms produced R89,220 (£8,922). These figures indicate unmistakeably the growth of the Indian power-loom *foreign* trade and the decline of the hand-loom. In a further page some idea will be given of the extent of the *home* market for jute goods.

Local or Home Consumption.

Local Consumption.

It should be carefully observed that the returns published by Government show only the exports, properly so called, of bales of prepared gunny-bags, gunny-cloth, or jute rope as such. They do not include the millions of gunnies, &c., which annually leave the ports of India containing grain or other produce, nor those used for home purposes or sent to other parts of India. These figures do not, therefore, show the whole outturn of gunnies annually manufactured in India. In fact, from January to December 1882, 119,042,771 gunnies were actually made by power-looms, of which only 41,523,607 were exported; so that the exports were barely one-

3 MANUFACTURES. Home Consumption.

third of the number actually manufactured. The following table will show the relations of the home consumption to the exports more clearly:—

Statement of Home Consumption and Exports of GUNNIES *from 1st January to 31st December 1882.*

Burma	13,312,306	
Straits	9,153,233	
Bombay and Persian Gulf	20,001,308	
Madras and Malabar	1,064,848	
Coromandel Coast	3,609,950	
Ceylon	177,777	
Up-country by rail	11,351,000	
Used in the export trade of Calcutta	11,848,742	
Total of Home Consumption	...	77,519,164
Australia	11,372,387	
New Zealand	5,060,160	
Cape of Good Hope	706,308	
Mauritius	119,078	
Egypt	691,078	
America	20,554,251	
Hongkong (not Hessians)	413,700	
Great Britain	516,417	
Europe	90,231	
Total of Foreign Exports	...	41,523,607
Grand Total of Home Consumption and Foreign Exports	...	119,042,771

The total number of gunny-bags brought to, and carried from, Calcutta during the past three years may be here given and alongside of these the foreign exports:—

	1884-85.	1885-86.	1886-87.
Imports	18,196,002	20,626,541	23,586,402
Total Exports (to other provinces of India and to foreign countries)	137,870,318	127,084,964	124,957,225
Foreign exports only	82,779,207	63,760,546	64,572,157

The difference between the total exports from Calcutta and the foreign exports approximately represents the home (Indian) consumption, although there is doubtless a balance between the total of production + imports and the exports, which would represent the Calcutta local consumption. This in 1882 was estimated to be over 11 million bags, so that last year the total production of gunny-bags in Bengal was perhaps little short of 150 millions, of which 64½ millions were sent to foreign countries and 85½ millions used up in India. This may be accepted as representing the bags employed in the home, cotton, oil-seed, rice, and wheat trade, and in the export trade of India.

But in addition to gunny-bags India exported last year 12,799,225 yards of gunny-cloth, valued at R9,80,741, and this exclusively of the interportal trade which amounted to 5,728,858 yards (nearly the whole of this quantity going to Bombay), making a total of 18,480,001 yards as against 25,267,418 yards in 1885-86, and 19,923,884 yards in 1884-85. But in addition to these returns of gunny-cloth conveyed by sea, the Report of the River-borne

Traffic of Bengal for 1887 states that 605,846 pieces were sent up-country by river "direct from the jute mills without passing the Port Commissioner's wharves." A piece of power-loom gunny is equal to 80 yards, of hand-loom, to 22 yards, so that this power-loom trade alone represents close upon 50,000,000 yards of cloth, an amount that was conveyed to Durbhunga, Monghyr, Bhagulpore, Patna, Moorshedabad, Nuddea, Purneah, Chumparun, Rajshahye, the list concluding with an entry marked "for all other districts," 12,625 pieces. The districts are enumerated in the order of importance, Durbhunga having received 221,630 pieces, or fully a third of the total amount, while Monghyr took 164,556. Large though these quantities are we are left no other inference than that there must be a very considerable trade conveyed by railway, road, and river to the other provinces. Accepting the published figures as they stand, however, we thus learn that the internal trade in gunny-cloth is three or four times as great as the foreign exports. Some difficulty exists in working out the total internal trade, as in many of the returns of railway traffic gunny-bags and gunny-cloth are treated collectively, while in others they are given in maunds, or again in yards, &c. But enough has been said to convey a tolerably clear conception of the extent of the internal trade both in bags and cloth. It may be added, however, that the bulk of the hand-loom industry is conducted in Dinagepore, Purneah, Rungpore, Julpaiguri, and Tipperah; Julpaiguri turned out last year 2,336,660 and Rungpore 1,222,410 hand-loom made bags.

3 MANUFACTURES. Home Consumption.

CLASSIFICATION OF THE JUTE MANUFACTURES.

CLASSIFICATION OF MANUFACTURE.

The manufactures from *jute* or *pát* may be referred to three primary sections:—

I.—CLOTH of different qualities ranging from substitutes for silk to shirtings, curtains, carpets, and gunnies.

II.—PAPER chiefly prepared from the "rejections" and "cuttings."

III.—CORDAGE from the coarser and stronger qualities.

These three sections may each be referred to a number of sub-divisions, which for convenience may be arranged in two leading groups, *viz.*, native and indigenous manufactures, "hand-loom," and European or "power-loom" manufactures, whether made in Europe or in India. We shall first enumerate the indigenous manufactures, since these bear on the history of the industry.

INDIGENOUS MANUFACTURES.

Indigenous Manufacture.

Indigenous Cloth.—Every homestead in Bengal has suspended from a beam in the roof of the verandah a few bundles of jute fibre, which, while talking pleasantly with a neighbour, the peasant twists, with various kinds of spindles, into twine of varying thickness, intended for domestic purposes or for the yarn from which the women prepare the home-spun cloth or gunny-bags. Babu Ramcomal Sen, in the Transactions of the Agri.-Horticultural Society, describes three different modes of preparing twine or yarn in Bengal. The first is by means of a reel, called a *dhera*, the second by the *takur*, and the third by the *ghurgurra*. The first is said to be used in making yarn for gunnies, the second for fine yarns intended for cloth, and the third for twine to be afterwards made into ropes.

The natives weave three distinct kinds of jute cloth:—

1st, Thick cloth used for making gunny-bags. Of this there are three qualities, the best being known as *amrabati*. These correspond to the three qualities of hand-loom gunnies in commerce.

3 CLASSIFICATION OF MANUFACTURES.

2nd, Fine cloth.—This is generally known by the name of *mekli dhokrá*, and is chiefly used as a cloth to sleep on; it is often beautifully striped blue or red.

3rd, Coarse cloth.—This is largely used for making the sails of country boats (*gún*), and also for bags to hold large seeds or fruits.

The following are the principal districts in Bengal where indigenous jute manufactures (hand-looms) may be said to exist to any considerable extent:—Hugli, consuming about 1,20,000 maunds of jute a year; Dacca, 90,000; Rungpore, 50,000; Moorshedabad, 38,000; Malda, 25,000; Julpaiguri, Pubna, &c., smaller quantities.

European Manufactures.

European Manufactures.

Cloth made in Factories.—Jute is now largely used in the manufacture of carpets, curtains, shirtings, and is also mixed with silk or used for imitating silk fabrics. It has been applied extensively as a substitute for hemp: for this purpose the fibres are rendered soft and flexible by being sprinkled with water and oil, in the proportion of 20 tons of water and 2½ tons of train oil to 100 tons of jute. Sprinkled with this the jute is left for from 24 to 48 hours, when after being squeezed by rollers and heckled, the fibres become beautifully soft and minutely isolated, and thereby suited for a number of purposes unknown a few years ago.

The history of this trade is exceedingly interesting. In the year 1820 the fibre was first experimented with, but the result was unfavourable; and, in consequence, brokers were required to certify that sales of hemp and other fibres were not adulterated with jute. In 1832 an enterprising Dundee manufacturer experimented once more on the fibre, and the result was that he was able to show that it might be used as a substitute for hemp. From that date jute gained rapidly in public favour. It is one of those fibres that are capable of the most minute separation or subdivision, but only within the past few years has it been extensively used in the finer textile industries. For a long time the difficulty of bleaching seemed insurmountable, and the trouble experienced in dyeing the material appeared likely to nullify every effort to utilise it. All these stumbling-blocks have, however, been removed, and there cannot be a doubt that, but for the want of durability, jute would soon rank as the most valuable of all fibres. Its perishable nature, however, is fatal to its obtaining a position much higher than it has already attained, and probably admixture of jute in certain articles, such as sail-cloths, must sooner or later be viewed as a criminal offence. For information regarding the most recent developments of the European applications of jute see *Bull. Soc., Mulhouse, 1881.* The manufactures which occupy the attention of our Indian companies are almost exclusively the various forms of gunnies.

Jute Whiskey.

JUTE WHISKEY.

In concluding this account of jute it may be mentioned as a curiosity that it has been proposed to utilize the jute ends in the preparation of a spirit which somewhat resembles the whiskey made from grain. The waste fibre is by means of sulphuric acid converted into sugar and the resulting product thereafter fermented and distilled.

VOL. I.; PART II. (No. 16); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

The following pages have been simply struck off from the type used in the *Dictionary of the Economic Products of India* in the article on Sunn-hemp. This has been deemed necessary in order to complete the present special pamphlet on the more important fibres of India.

GEORGE WATT,
Reporter on Economic Products.

Simla, November 1888.

CROTALARIA juncea. Sunn-Hemp.

CROTALARIA, *Linn.; Gen. Pl., I., 479.*

13

A genus of plants closely allied to the Broom, the generic name being derived from the Greek κροταλον (a castanet), in allusion to the rattling noise made by the loose seeds within the inflated pods. This same idea, according to Sir Walter Elliot, is implied by the Sanskrit name *Ghantár avamu.*

Crotalaria Burhia, *Hamilt.; Fl. Br. Ind., II., 66;* LEGUMINOSÆ.

Vern.—*Sis, sissái, meini, pola, khippi, búta, khep, khip, khif, bhata, bái láthia, kharsan kauriála,* PB.; *Ghagari,* MAR.; *Ghugharo,* GUZ.; *Drunná,* SIND.

References.—*Dals. & Gibs., Bomb. Fl., 54; Stewart, Pb. Pl., 64; Aitchison, Cat. Pb. and Sind Pl., 37; Müeller, Select Extra-tropical Plants, 86; Murray, Pl. and Drugs, Sind, 112; Baden Powell, Pb. Pr., 508; Lisboa, U. Pl. Bomb., 231; Birdwood, Bomb. Prod., 130; Royle, Fib. Pl., 272; Rajputana Gas., 30.*

Habitat.—A low under-shrub, abundant in the sandy plains of Sind, Panjáb, Rajputana, and Cambay, ascending to 4,000 feet in altitude.

FIBRE. **Fibre.**—Is said by Mr. Baden Powell to yield a good fibre for cordage; used, to some extent, in the Panjáb in place of the *Sunn*-hemp (C. juncea) of other provinces.

MEDICINE. Branches. **Medicine.**—The branches and leaves are used as a cooling medicine.

FODDER. **Fodder.**—The *Rajputana Gazetteer* states that the plant is much valued as a fodder.

13. C. juncea, *Linn.; Fl. Br. Ind., II., 79.*

SUNN or SUNN-HEMP or INDIAN HEMP, FALSE HEMP, BROWN HEMP, BOMBAY or SALSETTE HEMP, WUCKOO-NAR (or TRAVANCORE FLAX), JUBBULPUR HEMP, &c., &c.

Syn.—C. TENUIFOLIA, *Roxb.*

Vern.—*San, sanai, sani* (or *sun, shon*), HIND., BENG.; *Ausá, suild,* ASSAM; *San, phulsan, arjha san,* N.-W. P.; *San tág,* BOMB.; *Sini, tágsan,* SIND; *San, suna,* GUZ.; *San, ghagharu tág,* MAR.; *San, tág, janab,* DEC.; *Jenappa, janumú, janapa* (or *shanapam*), TAM. and TEL.; *Janapa, pulivanji, vakkavanji, chanam,* MAL.; *Wuckú,* TRAVANCORE; *Sanabu. shanabind, pundi,* KAN.; *Pan* (?), *paikhsan, paik piven,* BURM.; *Hana,* SING.; *San,* PERS.; *Sana* (*ghantáravamu,* a generic name according to Sir Walter Elliot), SANS.

Dictionary of Economic Products of India, Vol. II., C. No. 2100.

According to some writers the name *Ambádí* or *ambárí* is, in Western India, given to this plant, but it seems probable that that name should be restricted to Hibiscus cannabinus. Indeed, it has been found difficult to arrive at any definite idea regarding the present area under *sunn*-hemp cultivation from the fact that the above Hibiscus appears to be confused with it. In Bengal, and indeed in some parts of the N.-W. Provinces, *sunn* or *san* is applied to the true hemp plant, a prefix being given to distinguish the fibre of Crotalaria, such as *Phul-sunn, Bhágá-sunn,* and *Bádál-sunn.* In Bengal this is known as *Chunpát.* But *pátsan* and *mestapát* are generally applied to Hibiscus cannabinus. Even the term *san* is thus often loosely used, being sometimes given to Hibiscus cannabinus, and at other times to jute. Indeed, *Sanai* or *Saní* is a safer name to use for this plant than the one in general use, *sunn* (*san* hemp). In the publi-

13 FIBRE.

cations issued by certain provinces information occurs regarding "Bombay hemp" as distinct from "*sunn*-hemp;" in others these are returned as one and the same substance, while **Cannabis sativa** and **Hibiscus cannabinus** are separately reported. It would thus appear that the term "Bombay hemp" is often, though incorrectly, given to the Ambádí fibre, **Hibiscus cannabinus**. It is thus unfortunate that, in modern commerce, the term "hemp" should ever have come to be applied to any but the true hemp plant, as, by this usage, widely dissimilar products have been almost hopelessly confused. The *sunn* is a bush closely allied to the English broom or the Indian *dál*, while the *ambárí* is a Hibiscus or cotton-looking plant with sharply-cut leaves not unlike those of the hemp plant,—hence the specific name **cannabinus**. The true hemp has its nearest affinity, of fibre-yielding plants, in the common nettle. The hemp fibres thus afforded by these three plants have little or nothing in common.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 545; Voigt, Hort. Sub. Cal., 206; Kurz, For. Fl. Burm., I., 331; Kurz, Contrib. to Burmese Fl., 266; Gamble, Man. Timb., 117; Gamble, List of Pl., Darjeeling, 25; Thwaites, En. Ceylon Pl., 81; Dals. & Gibs., Bomb. Fl., 54; Stewart, Pb. Pl., 64; Aitchison, Cat. Pb. and Sind Pl., 37; Wight and Arnott, Prod. Fl. Peninsulæ Ind., &c., I., 183; Hem Chunder Kerr, Culivation and Trade in Jute, p. 6; Flora Andhrica, by Walter Elliot, 59, 60, 73; Moodeen Sheriff, Supp. Pharm. Ind., 119; U. C. Dutt, Mat. Med. Hind., 316; S. Arjun, Bomb. Drugs, 40; Murray, Pl. and Drugs, Sind, 112; Bidie, Cat. Raw Pr., Paris Exh., 117; Baden Powell, Pb. Pr., 342; Drury, U. Pl., 163; Duthie & Fuller, Field and Garden Crops, I., 82; Lisboa, U. Pl. Bomb., 231, 290; Birdwood, Bomb. Pr., 317; Royle, Fib. Pl., 270—293; Liotard, Paper-making Mat., 17, 27; Spons, Encyclop., 946; Balfour, Cyclop., 771, 843; Smith, Dic., 211; Treasury of Bot., 350; First Ann. Rep., Director of Agri., Bengal, lxxiv.; Manual of Trichinopoly by Moore, 72; Manual of Coimbatore Dist., Nicholson, 238-239; Mysore Gas., I., 95; Bomb. Gas., II., 63; III., 54; XI., 97; XII., 163; XIII., pt. I., 290; XVIII., 48; XXIV., 172; Bengal Ad. Rept., 1882-83, 15; Panjáb Gas. (Kangra Dist.), p. 153; N.-W. P. Gas. (Meerut), 233; (Cawnpore), 27; Agri-Hort. Soc. Ind. Jour., Vol. VII., pt. III. (New Series), pp. 224-227; Sett. Rept., Upper God. Dist., C. P., p. 36; Ramshunker Sen, in Agricultural Gazette, January 1874, 162-163.*

Habitat.—The *Flora of British India* gives the habitat of this plant as "Plains from the Himálaya to Ceylon, but often planted for its fibre." The writer is not aware of **Crotalaria juncea** having been recorded as found in a wild state anywhere in India, although it may sometimes exist as an escape from cultivation. **Kurz** says of **C. juncea** in Burma "like wild along the banks of the larger rivers, especially the Irrawaddi," and **Griffiths** that **C. juncea** is met with in Afghánistán. **Roxburgh** describes a form (by modern botanists reduced to the present plant, *vis.*, **C. tenuifolia**) which he states is a native of Coromandel. Many writers, however, familiar with the living plants, still affirm that **C. juncea** and **C. tenuifolia** are distinct. They seem at least to be cultivated recognisable states which, owing to the reputed superiority of the fibre of **C. tenuifolia**, it might, for economic purposes, be desirable to treat of separately. As a historic point of some interest it may be here added that, after **Roxburgh** reported the discovery of **C. tenuifolia** in a wild state in Coromandel, it was next found under cultivation at Jabalpur, where it seems to continue to be cultivated to this day, although as yet it has not been reported as found anywhere between these remotely distant regions. At the same time **C. juncea** is cultivated more or less in every province of India, competing for popular favour with **Hibiscus cannabinus**, until in some parts of the Panjáb and Sind its place is taken by the wild species **Crotalaria Burhia**, which yields a fibre of such quality as to render the cultivation of **C. juncea** superfluous.

CROTALARIA juncea. History of Sunn-Hemp.

13 FIBRE.

SUNN (or SAN) HEMP FIBRE.

Under the heading **Cannabis sativa** the suggestion has been offered that the Greek and the Latin *cannabis* may have been derived from the Arabic *kinnab*, a name which seems to have been adopted from the Persian *kanab*. The author of the *Makhzan-el-Adwiya*, while giving that derivation, adds that the Syrian for the plant is *kanabira*. But the word *cannabis*, however derived, has less of interest associated with it than the Sanskrit *Sana*. There are, for example, three fibre-yielding plants which appear in early literature to bear that name or some derivative from it. It even may be doubted if the *sana* of the earliest writers is the hemp of modern commerce. In the unmistakable references to hemp in Sanskrit, care is taken to associate with the plant qualifying and descriptive epithets that convey the idea of the well-known narcotic properties of the plant. Even the Hebrew *shesh*, generally translated flax, is suggestive of intoxication, and hence the possibility of its having been used for hemp rather than flax. DeCandolle has established very conclusively that a form of flax was grown in Europe before the time of the Western Aryan migration, although the plant now cultivated for flax seems to have followed the path of that great civilization, having been apparently cultivated by the Aryans prior to their invasion of Europe. This conclusion is founded mainly on the fact that the root of the word "linen" did not exist in Europe prior to the period indicated, and he adds that it does not occur in the Aryan languages even of India. The mummies of Egypt are draped in garments of flax or linen, but there is nothing to justify the supposition that the Egyptians of that day knew of the hemp plant, although they were familiar with flax. Thus even the history of flax is in some instances involved with that of hemp, such names as *shesh* implying an intoxicating power—a property of the hempen fibres possessed alone by **Cannabis sativa**. The *sana* fibres of the Sanskrit authors are **Crotalaria juncea** (*sunn* hemp), **Hibiscus cannabinus** (*sanpát*), and **Cannabis sativa** (true hemp of modern commerce). As already stated, there would seem to be every chance that the earliest writers allude under *Sana* to the fibre of **Crotalaria juncea**, but that, as the true hemp became known, care was taken by subsequent authors to distinguish it by the use of qualifying and descriptive words that implied its intoxicating properties. It seems possible also that the narcotic of **Cannabis sativa** was known before the discovery of the fibre yielded by the plant, although the name *bhánga* signifies to break, an idea probably suggested from the breaking or isolating of the fibrous bark from the stems, but that idea might have arisen from jute, sunn hemp, or any other bark fibre. In many instances no room for doubt is left as to the peculiar *sana* referred to. Thus in the *Ain-i-Akbari* (Gladwin's Translation) the plant is described as bearing yellow flowers—a fact that clearly fixes **Crotalaria juncea** as the *sana* there alluded to; but in further discussing the hempen fibres there occurs the following passage: "One species bears a flower like the cotton shrub, and this is called in Hindustani *sanpát*. It makes very soft rope." Here we have a distinct allusion to **Hibiscus cannabinus**.

Kshauma.

Frequent reference is made in the *Rámáyana* and the *Mahábhárata* to a garment called the *kshauma*. *Kshaumá* is by mostwriters viewed as a name for linen, but the resemblance to the Chinese *chu-má* (or *schou-má*), the name for grass-cloth, is worthy of mention. Certain synonyms occur for the *kshauma* which convey some idea of the material of which it was made. Thus *umá* or *atasí* (the *atasí-vastram*) would be the linen-made, the *patta-vastram* the Hibiscus-made, and *sana-vastram* in all probability the sunn-hemp-made garment. Later writers speak of *sana*

13 FIBRE.

garments as being used as sackloth and worn as a mark of punishment or mortification. A prophecy in the *Vishnu Purana* speaks with scorn of the Kaliyuga (or iron) age as one of degeneration, "when the garments of men will be like the *Sani*." It thus seems established that a gradual evolution in popular opinion took place until (as in the present day) *san* and *san-pát* were no longer used as textile fibres, but were relegated to the position they at present hold as useful fibres for cordage and sacking. The hill tribes of the North-West Himálaya weave a proportion of their clothing of hemp, but although the plant springs up wild all over the plains of India its fibre is but very rarely extracted. The people during all modern historic times have been clad chiefly in cotton, and it is somewhat remarkable that this should not have been the case from remote times, seeing that, as far as we can learn, one of the floss-yielding species of Gossypium (cotton) is truly a native of India. In the *Institutes of Manú* (*Book II., 44*) we have an early allusion to cotton. "The sacrificial thread of the Brahmin must be of cotton, and so as to go over his head in three strings; that of a Cshatriya of *sana* thread only; and that of a Vaisya of woollen thread." It is believed that the substitution of cotton for the *sana* has been carried, at the present day, to the extent of violating even this injunction. Lisboa (*Bombay Useful Plants, p. 290*) states: "It appears that Manú being a Brahmin, always tried to keep this distinction, and claimed superiority for his class. But, nowadays, the sacred threads of almost all the Hindus are made of cotton."

Sacred Threads.

While **Cannabis sativa** is found at the present day in what appears to be a wild state over the greater part of India there is little to justify the opinion, held by popular writers, that it is indigenous, nor can it be even said to be a native of Persia, though it may possibly be of China, as it is of Russia, Siberia, and Kirghiz. On the other hand, **Crotalaria juncea**, while met with to-day almost exclusively under cultivation, would appear to be a native of India, and possibly also of Central Asia; many other species of the same genus are abundant wild plants. This fact, added to the inferences to be drawn from Sanskrit literature, point to the conclusion that it is highly probable the *sana* of the early writers was **Crotalaria** and not **Cannabis**. It is scarcely possible that the people of India as a whole should have lost all knowledge of the properties of a fibre once in general use and obtained from a plant which grows so freely, if in early times the true hemp was indigenous, or even was as abundant as it is now. There is, indeed, no evidence of hemp ever having been used in comparatively modern times as a regular textile fibre, and with the exception of the limited extraction of fibre pursued by the hill tribes, the natives of India do not utilise the wild or even the cultivated hemp plant as a source of fibre, but prefer to cultivate *sunn* hemp (**Crotalaria juncea**) or *san-pát* (**Hibiscus cannabinus**) for the cordage and sacking required for agricultural purposes. There is still a further consideration, and one of some importance,—*viz.*, that on the plains of India the hemp plant does not produce fibre of any value. Unless, therefore, we are to presume that it has degenerated, or that the climatic conditions of India have altered, the ancient people of the plains were not likely to have obtained their *sana* fibre from **Cannabis sativa.**

We may conclude this brief historic review of the hemp plants by giving the opinions that prevail regarding the origin of our word "hemp." Royle in his *Fibrous Plants of India* traces hemp from *sana*. Speaking of *sunn*-hemp he says: "Its name, Shanapam or Janapa on the Madras side, is not very unlike Canapa, Hampa, Hennip, and Hanf. From these we derive our own name 'Hemp.'" In Mysore it is known as *sanabu*

CROTALARIA juncea. **Cultivation of Sunn-Hemp.**

FIBRE.

and in Ceylon as *hana*. On the other hand, the root of the word *an* or *ang* may be traced from *bhánga*, a synonym for *sana*, met with in the Atharva Veda. De Candolle says this root occurs in the names of the true hemp in all the Indo-European and modern Semitic languages, thus: *bhánga* and *gánja* in Indian languages, *hanf* in German, *hemp* in English, *chanvre* in French, *kanas* in Keltic and modern Breton, *cannabis* in Greek and Latin, and *kannab* in Arabic.

CULTIVATION.

Cultivation.

Sunn is grown by itself or at times is cultivated in strips or around the margins of fields. It is never cultivated as a mixed crop. Throughout India as a whole it is a *kharif* crop,—that is to say, it is sown about the commencement of the rains and cut at the end of September or beginning of October. It is thus off the ground to allow of being followed by a *rabi* crop in the same year. But in some parts of India there are two crops of *sunn* hemp. Thus in the Thana District of Bombay it is sown in November after the rice harvest, and the stalks are pulled up by the root in March. "It is also sown as a rainy-season crop in sandy soils" (*Gas., XIII., I., 290*). This system has prevailed in Thana and Surat for at least the past 100 years, for Dr. Hove, writing in 1787, says: "The Crotalaria was sown very thick and grew to the height of 10 feet, remarkably straight and slender. I understand that it was sown in the beginning of November after the grain had been gathered in." In Khandesh it is sown in June and reaped in October. In Kolaba it is sown in November, after the rice is harvested, and the stalks are uprooted in March. In Kolhapur it is sown in August and harvested in December by being cut when the plants are full grown. In Poona it is sown in July and ripens in October. In the Central Provinces and the North-West Provinces it is a *kharif* crop, being sown with the advent of the rains; but in Bengal it is sown a little earlier, namely,—from the 15th April to 15th June; in Madras the sowings take place even still earlier. In the experiments performed at the Saidapet farm, Madras, *sunn* was sown on the 2nd of February. In the *Ain-i-Akbari* the plant is described as bearing its yellow flowers in spring—a fact which Mr. Hem Chunder Kerr (writing of Bengal) expresses some astonishment at, since "it now flowers in the rainy and cold seasons." Roxburgh says it is sown in Bengal in May and June, and flowers by August,—that is to say, towards the end of the rainy season. In the last Agricultural Report of Bengal it is stated that the crop is harvested from the 15th of August to the 15th of September. Royle remarks that at Commercolly there are two kinds grown —one sown in June and cut in August, the other sown in April. But this second kind, he adds, is in Dacca sown in October. Thus while the mean period of sowing is about the beginning of the rains (or in June), *sunn* hemp may be sown in almost any month and occupies the soil for 4½ to 5 months. This is an important feature in view of the possibility of securing a continuous supply of fresh fibre throughout the whole year. It remains to be ascertained, however, what effect this varying period of cultivation has on the quality and quantity of fibre produced. Indeed, it is probable that (as is the case with rice and other crops sown at two or more seasons each year) there may be different cultivated forms of the plant produced as the result of ancient cultivation. We are ignorant of this subject, and it seems desirable that a thorough investigation should be made. Although, as stated, everything points to *sunn* hemp being a native of India, it may be doubted if the plant has ever been found in a truly wild state. And the existence of distinct cultivated forms might not only help to confirm the opinions given of an ancient cultivation, but

might also establish the superiority of certain crops over others for textile purposes. To what extent the form **C. tenuifolia** is cultivated is not known, still less do we know how far it affords the superior *sunn*-hemp referred to by writers on this subject.

13 CULTIVATION of the FIBRE. Soil.

Nature of the Soil recommended for Sunn-hemp.—It requires a light but not necessarily rich soil, and it cannot be grown on clay. It is therefore sown on the high sandy lands less suited for the more important crops. This is the opinion which prevails in Bengal, but **Messrs. Duthie and Fuller**, writing of the North-West Provinces, say: "Authorities differ as to whether a rich soil is necessarily required, and although there can be no doubt that fertility in the soil is necessary to promote great luxuriance in its vegetation, yet it cannot be contested that *sanai* will grow on poorer land than almost any other crop. One possible explanation of this may lie in the theory that plants of this order" (the pea family) "can assimilate nitrogen direct from the atmosphere, and are hence less dependent on the soil for nourishment; and another explanation may be deduced from the fact that its roots penetrate deeper than those of most other crops, and can hence draw supplies from a larger body of soil." At the same time the practical experiments performed at the Saidapet farm, Madras, tend to prove that the plant would not produce so much fibre on rich as on poor soil. Speaking of these experiments **Mr. Benson** says: "The seed germinated well, and the plants grew with great luxuriance, but when they had reached the time for cutting, there was no fibre whatever in their stems. The soil of this plot was a sandy loam, and probably the high cultivation and watering were unfavourable to the production of fibre." A second experiment was performed, the seed being sown on "a light and very sandy loam, recently levelled." The land was manured with "12 loads or about 4 tons per acre" of horse-manure, and the results were most favourable. In the *Mysore Gazetteer* it is stated that the best soil for *sanabu* is the red or black used for *ragí* cultivation. **Wisset** remarks that clay soils are injurious, but that on a rich soil the fibre is of a coarser quality than that grown on dry high situations. On the other hand, **Roxburgh**, while speaking of the cultivation in the Northern Circars, says it (this may be **C. tenuifolia**) is sown towards the end of the rains (October or November), and that a strong clayey soil suits it best.

Rotation.

Effects of Sunn Cultivation and the Rotation of Crops Pursued.—It is all but universally believed by the Indian cultivators that *sunn*, like *gram* (see **Cicer, C. No. 1067**), improves the soil. In the *Bombay Gazetteer* (Kolhapur District, p. 172) it is stated: "As it is supposed to refresh the exhausted soil, it is considered a good *bevad* or preparatory crop, and is grown as such every second or third year in some of the fields required for sugar-cane, tobacco, and other rich crops. Sometimes it is sown as a second crop and ploughed in when young as a green manure." From Poona it is reported that the leaves are considered "excellent manure." In gardens and occasionally in dry-crop lands it is "grown solely for manure, the plants being ploughed into the soil when ready to flower." The Director of Agriculture in Bengal states: "It is considered by the people of the Lower Provinces to be a renovating crop, and is sometimes used as a green manure to enrich poor paddy land and land that has been infested with weeds." He adds: "It comes after one of the pulses or mustard, and is followed by a pulse, sometimes by *shara* onions. When *sunn* is grown on good soil, it is sometimes followed by potatoes. It is not necessary to prepare the land well for *sunn*. Three or four ploughings are sufficient." . . . "Sometimes also paddy and *sunn* seeds are sown together in the same field. When the plants have properly

CROTALARIA juncea. **Cultivation of Sunn-Hemp.**

13

CULTIVATION of the FIBRE.

grown, the field is lightly ploughed and the ladder (a kind of harrow) is passed over it. The paddy plants mostly recover themselves, but the tender and juicy *sunn* is buried underground and dies. A few *sunn* plants remaining are removed at the time of weeding and buried in the soil. The ryots say this green manuring does as much good to the paddy as the application of a maund of oil-cake per bigha. This practice is not, however, very widely extended, though the advantages of it are well known in Burdwan. It involves early ploughing of the paddy lands, and some extra labour which the ryot is not always able or willing to give." Messrs. Duthie and Fuller say of the North-West Provinces: "Ploughing in a green crop of hemp is known to add considerably to the fertility of the surface soil by increasing its stock of nitrogen, and it is extraordinary that this is not a general practice with native cultivators." In Bombay *tág* (*sunn*) is not considered a good green manure for wheat.

TREATMENT.

Tillage, Sowing, and Harvesting.—As indicated above, the opinion prevails all over India that high cultivation is not necessary for sunn-hemp. Of Kolaba (*Bomb. Gaz., XI.*, 97) it is said: "The soil is roughly ploughed twice and the seed sown broadcast." In Bengal "the seeds are sown broadcast. It is necessary to have the plants grown thick, otherwise they become bushy and coarse and give very inferior fibres." "There is nothing more required after sowing till harvest time." In the North-Western Provinces "two ploughings at most are given, and the seed is sown broadcast at the rate of one maund to the acre and ploughed in. It germinates quicker than any other crop, the seedlings showing above ground within 24 hours after being sown. Irrigation, even when necessary, is rarely given, and no weeding is required." In the experiments made in Madras, to which reference has already been made, it was apparently sown in drills. "The land was prepared for an ordinary crop by ploughing and harrowing until it was reduced to a proper state, and the seed was then sown with the drill in rows 9 inches apart at the rate of 12lb per acre." In the Coimbatore district, where excellent *sunn* hemp is grown, the seed is sown broadcast, then ploughed in and the land formed into plots and watered twice a week from July to November (*Manual of Coimbatore*, by Nicholson, *pp. 238-39*). Of Mysore it is stated: "It is allowed no manure; and the seed is sown broadcast on the ground, without any previous cultivation, at the season when the rains become what the natives call male,—that is to say, when they become heavy. After being sown the field is ploughed twice, once lengthwise and once across; but receives no further cultivation. At other times the *sanabu* is cultivated on rice ground in the dry season, but it must then be watered from a canal or reservoir."

Bombay. Bengal. N.-W. Provinces. Madras. Mysore.

SEED per ACRE.

Seed.—The amount of seed to the acre is variously stated. In the above passage from a report of experiments in Madras only 12lb to the acre were used, but in the North-Western Provinces about one maund (or 80lb) to the acre is general. In Bengal 20 seers (40lb) to the *bigha* (⅓ of an acre) is the customary amount of seed. Roxburgh states that from eighty to a hundred pounds weight to the acre were used in his time. The plants should not be more than 2½ to 3 inches apart each way, and hence thick sowing is desirable.

HARVESTING. With Flowers. With Fruits.

Harvesting and Yield.—It is customary to read that the crop is harvested after the flowers have appeared, but in certain localities the plants are left on the field until the fruits have begun to form, and in some instances even until they are ripe. In most cases the plants are pulled up by the roots, in others the stems are cut with a sickle close to the ground. Of the Poona district, Bombay, it is stated that the crop is "left standing for about a month after it is ripe, that the leaves, which are excellent manure, may fall on the land." It is not clear whether the crop is left on its roots,—

Production and Cost of Sunn-Hemp. CROTALARIA juncea.

that is to say, not reaped,—or whether it is cut and stacked on the fields—the latter more probably. The greatest difference of opinion prevails as to whether the cut crop should be dried before being steeped, or, like jute, be carried at once to the retting tanks. But even with jute some cultivators dry the plants sufficiently to allow of the leaves being rapidly stripped, since these are supposed to injure the colour of the fibre if allowed to rot in the water of the tank. With regard to *sunn* hemp, the general rule may be almost safely laid down that in moist regions, like Bengal, rapid submersion is preferred, and in dry regions, like Madras, stacking the crop is practised. Roxburgh from actual experiments arrived at the opinion that "steeping immediately after the plant is pulled is the best, at least in Bengal during the rains, for then it is very difficult to dry it, and the fibre becomes weakened and the colour injured." Royle (*Fib. Pl.*), on the other hand, states that the strongest opinions have been expressed in favour of first drying the plants before retting, the probability being, as indicated above, that both theories are correct, but applicable to different climatic conditions. Of the Coimbatore district, Madras, for example, it is stated: "The cuttings are left on the field until thoroughly dried, then shaken to get rid of the leaves and pods, bundled, and stacked in thatched heaps till required." Here the stems are not only dried but left indefinitely, instead of having their fibres removed and cleaned at once. It is worth adding, in connection with this remarkable practice, that Coimbatore is supposed of all Madras districts to produce the finest *sunn* hemp.

12 CULTIVATION of the FIBRE.

Left standing for a month.

Steeped at once.

Fibre not removed from bark till required.

THE PRODUCE PER ACRE—Is so variously stated that it is feared little reliance can be put on the figures. Wisset says that it varies from 3 cwt. to 10 cwt. per acre, or, say, a medium of 700lb. In the Kolhapur District Gazetteer, on the other hand, it is stated: "The average acre outturn of Bombay hemp is 150 pounds." In the Madras experiments made at the Saidapet farm the results were for plants in flower, cut level with the ground, on the 4th December, 300lb, pulled up by the roots on the same day 325lb; on the 15th December, when the seed-pods had partly matured, cut level with the ground 425lb, pulled up by the roots 487·5lb; and on the 24th December, when the seeds were ripe, 437·5lb. The average given by Wisset is thus most likely to be a high one and the Kolhapur returns incorrect. Duthie and Fuller say of the North-West Provinces: "The average outturn is about 8 maunds (or 640lb) of clean fibre to an acre, worth about R20."

PRODUCE.

640 lbs. per acre.

COST OF CULTIVATION AND LOCAL PRICE OF FIBRE.—Messrs. Duthie and Fuller give the cost of cultivation in the North-West Provinces, including R5 for rent of land, at R15-6, thus leaving a profit of R4-10. In the Madras experiments "the total cost of cultivating an acre" is given as R14, but this does not appear to include rent of land. Royle says: "The cultivation was said to yield a tolerable profit, inasmuch as the plant requires scarcely any attention and consequently little labour or expense; and it may be off the ground in time to allow this to be prepared for any cold-season crop. But the expenses and the profits are as variously stated as the produce. The price is also given as varying from R1-8 and R1-12 to R3 per maund." Duthie and Fuller state that 640lb are worth R20, or, say, R2-8 a maund, but that "the value of *arjhasan* has suffered great fluctuations in late years. The Settlement Officer of Allahabad writes that in 1877 its price was as high as 6 seers (12lb) per rupee, whilst a few years back it stood at 20 seers. The Calcutta price is about R5 a maund. Dr. Buchanan-Hamilton describes two crops of *sunn*-hemp as grown in his time in Mysore. Of the one he remarks the seed is sown any time after the rains, and rather thick, the quantity used being two bushels to the acre. The produce was sold by the cultivators to the Telinga Chitties or

COST.

CROTALARIA juncea. — Area under Sunn-Hemp.

13 COST.

manufacturers by the thousand handfuls of the dried stems; tall plants fetched two rupees per thousand handfuls, and short plants a rupee and a half. But another crop, he says, was sown in January. This crop had to be watered and more labour spent upon it, but the produce was more valuable. An acre, he says, required $4\frac{8}{10}$ bushels of seed, and its produce was sold for about £1 2*s.* 10½*d.*

AREA. N. W. P. 40,000 acres.

AREA UNDER SUNN-HEMP.—As may be inferred from what has been stated regarding the ambiguity in the Indian literature of this subject, it is next to impossible to discover the extent of *sunn*-hemp cultivation. Messrs. Duthie and Fuller, from special returns furnished for their *Field and Garden Crops*, state that in the North-West Provinces there are about 40,000 acres under the crop. But in the *Land Administration Report for 1885-86* (page 163 A) it is stated that there were 198,728 acres under "*Sanai* or *Til* (sic)." But it is further remarked that the total area under "fibres other than cotton and jute" was in that year only 123,403 acres. This last return would include hemp (proper), *sanai* and Hibiscus cannabinus. The Settlement Reports of Oudh show about 800 acres under *sanai*. In *Spons' Encyclopædia* it is stated that there are 50,000 acres in the Panjáb. It is not known from what source that statement was derived, but it seems highly improbable that there is more *sunn* grown in the Panjáb than in the North-Western Provinces. The returns of the Panjáb give about 40,000 acres under "hemp," but how much of that may be the true hemp plant, how much Hibiscus cannabinus, and what balance remains as *sunn* hemp, it is impossible to discover. Last year there were 26,614 acres of brown hemp (Crotalaria juncea) grown in Bombay. Full particulars regarding Madras cannot be obtained, but of the districts for which returns are available there were last year 775 acres under "sunn" and 83 acres uuder "Bombay hemp." What this Bombay hemp may be cannot be learned, but in most works on the subject Bombay hemp is a synonym for *sunn*-hemp. In 1884-85 there were 380 acres of "Bombay hemp," and in 1885-86, 330 acres, so that its cultivation would appear to be declining. Of *sunn* cultivation in Coimbatore it is reported: "It can be grown anywhere and to any extent if a demand is made by agents with money in hand." In Travancore a very superior quality of fibre is produced, but it is not known to what extent the plant is cultivated. In the Central Provinces there were 24,800 acres under "False or San hemp," and in Mysore 5,076 acres. In Berar there were last year 569 acres under "hemp or Hibiscus cannabinus," but Dr. Hume in his recent report explains that there are in Berar two kinds of hemp—*ambada* and *san*. The former is in all probability Hibiscus cannabinus and the latter Crotalaria juncea. In Burma and Assam there are about 500 acres, in each province, of land entered as under "fibres other than cotton and jute." No returns are available for Bengal, but from personal observation the writer would be disposed to think there must be as much in the Lower, as in the North-West Provinces.

Panjab. 50,000 acres.

Bombay 26,614 acres.

Madras.

Travancore.

C. P. 24,800 acres.

Mysore. 5,076 acres.

Berar.

Burma. 500 acres.

Bengal.

It will thus be seen that the actual area under *sunn*-hemp cannot be absolutely determined, since the fibre is not included among the agricultural products regarding which regular annual statistics are furnished. But it seems probable that there are at least 150,000 acres annually under the crop in India as a whole.

India. 150,000 acres.

SEPARATION.

SEPARATION OF THE FIBRE.

The question as to whether the plant should or should not be dried before being placed in the retting tanks having been discussed above, there remains to be given here a brief account of the various modes of retting or of peeling the fibre and of cleaning and boiling it after it has been separated from the stems. In some localities the stems are recom-

Methods of separating Sunn-Hemp Fibre. CROTALARIA juncea.

mended to be buried in the mud at the margin of the tanks; in others, to be submerged in the water by being weighted. In others stagnant water is condemned as destroying the colour and lustre of the fibre, running streams being urged as preferable (*Gibson's account of the Bombay fibre*). But practical and comparative experiments not having been performed in the other provinces similar to those made at the beginning of the present century by Roxburgh, in Bengal, a definite opinion for or against the different methods pursued cannot be offered. After removal from the ground, the stems are tied in bundles (20 to 100 in each), but the leaves are generally stripped off and left on the field. When the stems are left until quite dry, the leaves either fall off naturally or are removed by the stems being beaten. It is a common practice to place the bundles of stems erect in 2 or 3 inches of water for 24 hours, so as to give the thicker and lower ends a longer submersion. But the length of time required for retting depends largely on the temperature of both the atmosphere and the water. In August and September two to three days will generally suffice. Messrs. Duthie and Fuller say of the North-West Provinces: "When stripped of the leaves they are ready for retting. The stalk is made up into bundles and placed upright for a day or two in water about a couple of feet deep, since the bark on the butts of the stalk is thicker and more tenacious than that on the upper portion, and requires, therefore, longer exposure to fermentation. The bundles are then laid down lengthways in the water and are kept submerged by being weighted with earth. The time required for retting varies from three days in hot and damp weather, to seven days if the temperature be cool and the air dry." It can generally be ascertained when the retting is complete by the bark of the lower ends of the stems separating easily, but too long fermentation, while it whitens the fibre, injures its strength. Roxburgh, writing of the period of retting, says: "All that seems necessary is to caution the cultivators against oversteeping the plant, which they are apt to do, because it renders the separation of the bark from the stalks easier, but weakens the fibre. Small pools of clear water, well exposed to the sun's beams, seem best suited for steeping in, because heat hastens maceration, consequently preserves the strength of the fibres, while the clean water preserves their colour. Deep water, being cooler, requires more time for the operation." In the same way running water, although recommended by some writers, would seem to be objectionable owing to the longer time necessary for the degeneration of the connecting tissues. Damp mud on the margins of tanks, referred to by some, is even more objectionable, as it seems impossible to adopt this mode of retting without serious loss to the colour of the fibre.

13 SEPARATION of the FIBRE.

Leaves stripped.

Length of submersion.

Stems placed erect in water, then horizontal.

Deep water. Running water.

Damp Mud.

Having discovered that the necessary degree of retting has been attained, the cultivator, standing in the water up to his knees, takes a bundle of the stems in his hand, and threshes the water with them until the tissue gives way and the long clean fibres separate from the central canes. According to some writers, the retted stems, after being partially washed, are taken out of the water and placed in the sun to dry for some hours before being beaten out in the way described. This practice, while it is followed in some parts of the country, is condemned in others as injurious, or at least as a useless delay. In Bengal this system is only followed when the operator is afraid he may not be able to overtake the task of washing before the stems would be over-retted. This partial drying of the stems with adhering fibre would correspond to the sweating of hemp pursued in some parts of Europe; but it seems probable that if sweating be necessary, it could better be accomplished as a further process after the fibre has been separated and approximately cleaned.

Cleaning of Retted Fibre.

In Salsette Island and other parts of Bombay, little or no retting is

CROTALARIA juncea. — **Cleaning Sunn-Hemp Fibre.**

13

SEPARATION of the FIBRE. Not Retted.

employed. "The plant while moist is peeled by the hand, and immediately dried in the open air or under cover, according to the state of the weather. By peeling, the fibres are better kept in their natural state of arrangement, and give support and strength to each other; whereas, by the process of the Bengalese, they get so materially entangled that a great loss is always sustained. If they are restored to their natural situation by the heckle, there is a loss of nearly one half of the original quantity, which renders the heckled *sunn* of Bengal of a high price" (*Royle*). The writer cannot discover any recent description of this Bombay process of separating the fibre without retting, but, as Roxburgh stated, the superior quality of Bombay over Bengal *sunn* hemp seems likely to be due to the fact that the fibre has not been subjected to strong fermentation.

Wages for cleaning.

Washing the fibre is very tedious, and a man rarely works for more than three hours at a time but is relieved by turns; he will clean 15 seers a day, which represents the fibre obtained from 5 or 6 maunds of stems. Of Khandesh it is said a man earns R1 for cleaning 40lb of fibre.

Period of cutting.

Reference has incidentally been made to the period when the crop should be cut, and before proceeding to discuss the further treatment of the fibre it may be as well to add here that the period of cutting will depend on the purpose for which the fibre is required. A softer and more delicate fibre will be obtained from stems cut just as the flowers appear than if allowed to pass into the fruiting stage. A few plants are always left by the cultivators to mature seed for the next year's crop, and from the stems of these they extract a strong, though coarse, fibre. On the other hand, it seems to be the habit of some cultivators (the Wunjaras of Bombay) to allow the whole crop to ripen its seeds, this coarse fibre being all they desire, together with the seeds, which are valued as a food for buffaloes. Old stems require a much longer period of retting.

Soft fibre.

Strong Coarse fibre.

Seed used as buffaloe food.

FURTHER CLEANING.

FURTHER PROCESS OF CLEANING THE FIBRE.—When the fibre has been separated and thoroughly washed, it is the usual custom to hang it up over bamboos to be dried and bleached in the sun. When dry it is combed if required for textile purposes or for nets and lines, but if for ordinary use—*e.g.*, ropes and twine—it is merely separated and cleaned by the fingers while hanging over the bamboo. In this primitive way the *sunn* hemp receives all the treatment it gets of the class known to European hemp growers as "breaking" and "scutching." European machinery for cleaning is never used. It is commonly admitted that it is in cleaning the fibre that the Native generally fails most. The process of washing after separation from the stems does not seem to be carefully done. Royle quotes a report of a sample of *sunn* hemp experimented with at Hull, of which it was stated that "by using more care in the steeping and exposure, it will be *fully equal* to the Baltic." Such opinions are current in the reports of this fibre which appeared, while the error existed of supposing it to be Indian-grown hemp or **Cannabis sativa**. It is impossible to avoid the impression that *sunn* hemp fell into disfavour when this error was exploded. An expert in 1842, for example, says: "Your hemp is very clean—a material point,—but it wants more beating and dressing; and I think the natives have not proper implements to do it with. You cannot improve in your mode of packing; it is decidedly superior to the Baltic. I do not despair of seeing the produce of the Baltic supplanted by that of India; as that defect appears to me solely to arise in the management of it: it stands too long before it is pulled or cut, or is too much steeped or exposed, to get the fibre to separate from the stalk." Unfortunately the advances of scientific exploration told all such writers that the defects they complained of were due to the fact that Bombay hemp was not hemp at all, and instead of the fibre supplanting

Breaking.

Scutching.

Said to be nearly as good as Baltic Hemp.

13

the Baltic hemp it is to-day in the same position commercially as it was a hundred years ago. While not hemp, it is a hemp substitute that deserves a better position than it has as yet obtained.

PROPERTY AND STRENGTH OF SUNN HEMP.

PROPERTY of the FIBRE.

Unlike the golden shining jute, which occurs in long straight bundles, *sunn* hemp, as usually met with in the market, exists in tangled masses of a dull, greyish-white colour. According to **Roxburgh's** experiments, it loses one third of its mass in heckling, but the tow obtained is useful for other purposes, such as for paper-making. **Royle** states that when heckled it is "light coloured and clean, with the fibres lying parallel to one another, and showing them as well fitted for spinning. Parties who have seen it have pronounced it well worth £35 a ton." At the beginning of the present century the East India Company endeavoured to improve the quality of the fibre by growing and manufacturing it carefully, and **Royle** mentions a sample of heckled fibre sent to London by the Company that measured four to five feet in length: the ordinary length of the heckled fibre, he adds, is only about three feet long.

£35 a ton.

EARLY RECORDS.

The first European mention of *sunn*-hemp occurs in **Rheede's** *Hortus Malabaricus*, V., IX., t. 26, but **Ironside** in the *Philosophical Transactions of London*, LXIV., page 99, also describes it. **Roxburgh** devoted much attention to this fibre, his first paper on the subject appearing in the Journal of the Society of Arts. Reference has been made to the fact that the East India Company, towards the close of the last century and the first few years of the present, cultivated the plant. The earliest definite mention we have of the fibre having been exported was in the year 1791-92. Although numerous favourable reports appeared shortly after this date, the whole interest in the fibre gradually died out, and the European methods of cleaning it met with a like fate; at the present day the natives nowhere practise any system of growing the plant, or cleaning the fibre that can be traced to European influence. One of the last outcomes of the desire to obtain flax and hemp from India was the issuing of instructions to the late **Dr. Roxburgh** to institute a thorough enquiry into the subject of Indian fibre-yielding plants. His report is the basis of all that has since appeared, for from that day to this, while much money has been spent in making collections of fibres and testing the properties of fibre-extracting machinery, no new and original investigations have been conducted in India with the fibres themselves. The following table gives the results of some of **Roxburgh's** experiments with sunn-hemp :—

First Exported.

No.	Names of the Plants.	Average weight each line broke with when *dry*.	Average weight each line broke with when *wet*.	Average weight gained by wetting the lines.
4	Sunn (**Crotalaria juncea**) cut before the plants were in blossom, and steeped immediately . .	112	158	41
5	The same as No. 4, but dried, or rather kept some time before they were steeped	60	78	30
6	Sunn cut when in full blossom, and steeped immediately	130	185	42
7	No. 6 kept drying for some time	100	166	66
8	Sunn, winter crop cut when the seeds were ripe and steeped immediately	150	203	35
9	The same as No. 8, but dried	110	163	48
10	Sunn, winter crop cut when the seeds were ripe, and steeped immediately	160	209	31

CROTALARIA juncea. — Properties of Sunn-Hemp.

13 PROPERTY of the FIBRE.

No.	Names of the Plants.	Average weight each line broke with when *dry*.	Average weight each line broke with when *wet*.	Average weight gained by wetting the lines.
1	Hemp, the growth of the year 1800 from the Co.'s Hemp farm near Calcutta	158	190	20
2	Jeetee (**Marsdenia tenacissima**)	248	343	38
29	A line made of 15 threads of sail twine (*Calloee*, **Bœhmeria nivea**)	240	278	16

Comparative value.

From these experiments there would appear to be no room for doubt as to the superiority of the rapid steeping as compared with the drying before retting. Further, the winter crop gave the best result. Indeed, casting one's eye down the long list of Indian fibres experimented with by Roxburgh, there are seen to be but two fibres that exceeded in strength the winter crop of *sunn, vis.* (No. 10), **Marsdenia tenacissima** and *rhea*, **Bœhmeria nivea.** The results of the experiments with these fibres, together with the experiments performed with hemp (presumably the true hemp), have been given in the above abstract from Roxburgh's table so as to allow of comparison. The sample of true hemp (Indian grown) gave a worse result than the winter *sunn* hemp prepared by immediate retting.

East India Company's efforts.

So far as they go, these experiments are of importance, but they leave the question of the comparative study of the *sunn* hemps of other provinces in a position of uncertainty. Of Bengal *sunn*, the rapid retting by Roxburgh's experiments seemed decidedly superior to the previous drying, but is this the case in Bombay and in Madras? and is the Bengal *sunn* inferior or superior to that of these Presidencies? This enquiry the East India Company do not appear to have taken into consideration. Their attention was first directed to the fibre in Bengal, and without ascertaining whether or not Bengal was the best field for experimental cultivation, they prosecuted the effort to improve the Bengal hemp, and failing, allowed the whole subject to drop into the oblivion from which it is only now beginning to recover; but the new trade is from Bombay, not Bengal.

Roxburgh's experiments.

Roxburgh tried the properties of *sunn* hemp in another way in order to ascertain the power of endurance which cords made of it had under maceration in water for a considerable period. At the same time he tested the advantages or otherwise of tanning or of tarring the fibres. The following abstract from his report may be here given—

Names of the Plants.	Average weight at which each sort of line broke.					
	When Fresh.			After 116 days' maceration.		
	White.	Tanned.	Tarred.	White.	Tanned.	Tarred.
English hemp, a piece of new tiller-rope.	105	...	...	Rotten, as was also the English log line.		
Hemp from the Company's farm near Calcutta.	74	139	45	All rotten.		
Sunn hemp of the Bengalese.	68	69	60	rotten.	51	65
Jute (*Bunghi-pát*) . .	68	69	61	40	49	60

Properties of Sunn-Hemp. CROTALARIA juncea.

13 PROPERTY of the FIBRE.

According to these experiments *sunn* hemp stood the action of the maceration better than did either of the samples of true hemp. It has further been shown that a cord 8 inches in size of best Petersburgh hemp broke with 14 tons, 8 cwt., 1 qr., while a similar rope of *sunn* only gave way with 15 tons, 7 cwt., 1 qr. Dr. Wight found that a rope of coir of a certain thickness broke with a weight of 224lb, of cotton with 346lb, of American aloe with 362lb, of *sunn* hemp with 407lb, of Calatropis gigantea with 552lb, and one of Ambárí (Hibiscus cannabinus) with 290lb. Royle has shown the slight deterioration which *sunn* hemp undergoes in the following statement: "A rope made in 1803 broke with a weight of 6 tons, 0 cwt., 3 qrs., whereas in 1806 it gave way under a tension of 5 tons, 17 cwt., 0 qr. It is of historic interest to add in this place that the trade in *sunn*-hemp lulled until the year 1867, when the export duty was removed. From that year returns of the trade of India were regularly published, and it is noteworthy that from about the middle of the present century the bulk of the exports of raw hemp (? *sunn* hemp) went from Bombay and not from Bengal, in spite of the efforts made a few years before that date to create a Bengal trade. This would seem to point to a superiority possessed by the Bombay as compared with the Bengal *sunn* hemp. It seems probable that had this fact been realised by the East India Company, their efforts to establish an Indian hemp industry would have been more successful than was the case with their attempts in Bengal.

Deterioration with age.

Removal of Export Duty.

RECENT EXPERIMENTS.

In a Report on the Indian Fibres by Cross, Bevan, King, and Watt, recently published by E. and F. Spon, the following passage occurs: "It is impossible to urge too strongly the claims of this much-neglected fibre—a fibre which seems to have suffered severely through the immense success of jute obscuring for a time the properties of all other fibres. At the beginning of the century *sunn* hemp occupied a much more important position than it holds to-day, and all efforts to cultivate the true hemp in India were abandoned, from the impression that the so-called indigenous hemp was, for all practical purposes, of equal merit. During the Colonial and Indian Exhibition numerous enquiries were made as to why it was that so little of the better qualities of *sunn*-hemp were procurable. Mr. Collyer and several other Brokers and Merchants stated that their only difficulty in pushing the trade in *sunn* hemp was their inability to procure a uniform and a large enough supply. From these and many other considerations we strongly commend this well-known fibre to the attention of the Government authorities of Western and Southern India. What encouragement they may be able to render may hopefully be anticipated to lay the foundation for a textile industry that may yet come to bear a creditable comparison with the jute trade of Bengal." The opinion expressed in the above passage that the *sunn*-hemps of Bombay and Madras are superior to those of Bengal is current in the literature of this subject, but it should be recollected that while we do possess the results of actual experiments with Bengal *sunn*-hemp, we have only general statements regarding those of Southern and Western India; but one fact remains in support of the supposed better quality of Bombay hemp,—namely, that the trade has migrated to the Western Presidency. At the same time Roxburgh seems to have been of opinion that Salsette *sunn* was superior to the *sunn*-hemp of Bengal, but he attributed the superiority to the mode of separating the fibre by peeling it off the stem instead of retting it. On the other hand, the *sunn*-hemp of Coimbatore (which obtained the medal at the Madras Exhibition), according to Roxburgh's experiments would have been improved had it been retted at once instead of being dried and stacked for an indefinite period before cleaning. If this be found by

Injured by Jute.

Future Prospects.

CROTALARIA juncea. Chemical Properties of Sunn.

13 FIBRE.

actual experiment not to be the case, then there must be something in the climate or soil of Madras and of Bombay more favourable to *sunn* hemp than exists in Bengal.

CHEMICAL AND MICROSCOPIC PECULIARITIES OF SUNN.

Messrs. Cross and Bevan (in the report quoted above) state that *sunn*-hemp treated "with iodine and sulphuric acid gives mixed blue and brown; with aniline sulphate, yellow streaks showing lignification. This fibre may be regarded, both chemically and structurally, as intermediate between the divisions of fibres A and B,"—*e.g.*, those suitable for higher and those for lower textile purposes. In their table giving the results of their analyses they show that when boiled for five minutes in a solution of caustic soda, it loses 8·3 per cent., and after an hour only 11·7 per cent. Among Indian fibres it occupies the third or fourth place in point of amount of cellulose. According to this classification, **Girardinia** or Nilgiri nettle heads the list with 89·6 per cent., then **Marsdenia** with 88·3, and after that **Crotalaria juncea** and **Sida rhombifolia** equal, each with 80·0 per cent. of cellulose. "The percentage yield of cellulose of the raw fibre is the most important criterion of its composition and value." It may be worth stating here by way of comparison that jute was found to possess 76·0 per cent.; **Musa**, or plaintain fibre, 64·6; **Anona** (custard apple fibre), 62·3; **Sesbania** (*dancha*), a fibre of great strength according to Roxburgh, 58·6; **Maoutia Puya**, a form of *rhea*, 32·7; and **Daphne**, the Nepal paper-plant, only 22·3 per cent. of cellulose. The last two have hitherto been popularly viewed as amongst the strongest fibres of India; and it would therefore appear that strength may not necessarily be a consequence of high percentage of cellulose. Without attempting to express an opinion opposed to Messrs. Cross and Bevan's results, the writer would throw out the suggestion that there apparently exists in some fibres a principle that may have been removed in the process of the analysis adopted by these distinguished chemists. While, therefore, it may be accepted as proved that such fibres as **Daphne** have ultimate fibriles that are too short to admit of their being bleached and thereafter spun in the form of the finer textiles of Europe, there still remains the practical fact that, under the crude methods adopted in India, they are valued as strong and durable fibres. It will be received with no small surprise by many that so humble a position should be assigned to the famed Poya fibre of Assam, and thus in concluding these remarks a possible explanation may be sought in the mode of hydrolysis (or washing and bleaching) employed. The Poya was found to lose 62·7 per cent. by being boiled in caustic soda, the residue being the cellulose upon which the low opinion of its properties is based. May it not be that under some other system of hydrolysis it would lose little or nothing, and even retain the property of great strength and durability for which it is justly esteemed by the fishermen of Assam for their lines and nets? The writer has for some time felt that one of the features of the exploration of unknown fibres should consist in the establishment, for each, of the peculiar mode of hydrolysis that injured the fibre least, and in chemical reactions that would check the natural degeneration it is liable to undergo. It seems scarcely fair to condemn or to praise a fibre according to its behaviour with one process of hydrolysis, and such a chemical result is likely to be often opposed to actual practical experience. It is satisfactory, however, to note that under a strong alkaline hydrolysis *sunn* hemp retains all its properties, and under nitration attains a great weight (150·5), being in this respect third in the list of the Indian fibres experimented with by Messrs. Cross and Bevan. A writer in *Spons' Encyclopædia* says of *sunn* hemp: "Samples of the fibre, exposed for two hours to steam

Percentage of cellulose.

13 CHEMISTRY of the FIBRE.

at 2 atmospheres, boiled in water for 3 hours, and again steamed for 4 hours, lost only 2·93 per cent. by weight, as against flax, 3·50; Manilla hemp, 6·07; hemp, 6·18 to 8·44." This hydrolysis (without the aid of an alkali) so far confirms the results given above, that in point of durability under moisture and under caustic alkali (processes of washing and bleaching), *sunn* hemp compares most favourably with other fibres, and deserves a far higher position in commercial enterprise than it has hitherto attained

MICROSCOPIC FORM.

Mr. King, who worked out the microscopic measurements of the Indian fibres in the recent report (quoted above), states that the fibre bundles consist of from 20-50 ultimate fibres which are not easily separated. He continues: "Fibres polygonal, cavity small. Fibre substance shows well marked concentric rings." Of the ultimate fibres he adds: "Length, 3-5 mm.; ends tapering abruptly; characteristic markings spiral." The writer in *Spons' Encyclopædia* gives microscopic results, however, that do not agree with the above—a fact which might suggest either that a wrongly-named plant may have been examined, or that *sunn* hemp varies to an alarming extent. He says: "The dimensions of the filaments are—length: max., 0·472 in.; min., 0·157 in.; mean, 0·30 in.;—diameter: max., 0·0020 in.; min., 0·001 in.; mean, 0·0015 in. These measurements are in round numbers double those given by Mr. King—a fact that would suggest the desirability of the subject being looked into once more, especially by having samples of Bengal, Bombay, and Madras *sunn* examined and compared. It would also be of great interest to have microscopic and chemical experiments made with fibres obtained from plants in flower and from those in all stages of maturity of seed, both separated by the immediate retting process and by the process of drying before retting.

Re-examination desirable.

Trade in Sunn Hemp.

TRADE.

Little or nothing can be learned of a definite nature regarding the extent of the trade in this fibre. It is grown in every province, and nearly universally used by the people of India; but, as already stated, definite information is not procurable owing to the confusion which exists in the use of the word "hemp" (*sunn* hemp in one case, Hibiscus in another, and true hemp in a third, being the fibre alluded to). For this same reason we are unable to discover the extent of the foreign trade in *sunn* hemp. It seems probable, however, that of the exports to foreign countries shown under Indian-grown hemp the bulk is *sunn* hemp, while of the imports from other countries the bulk of the "raw hemp" may be Manilla hemp (**Musa textilis**), and of the "hemp manufactures" articles made of true hemp. We have said that shortly after the East India Company discontinued their efforts in Bengal to cultivate the plant and to extract the fibre according to European methods, a trade in *sunn* sprang up and gradually developed into a position of importance in Bombay. The exports of Indian-grown hemp* were, in 1867-68, valued at R1,04,127, but, by Act XVII. of 1867, the export duty was repealed, and in the following year they were R2,91,355, and in 1869-70, R5,07,159; of the last-mentioned exports the United Kingdom received R4,35,930 worth, France R17,274, America R5,621, and the Persian Gulf R34,029. Bombay furnished R3,12,111 worth and Bengal only R78,926, the remainder going from Madras. From these facts it will be seen how important a slice of these so-called exports of Indian hemp goes to Britain, and of how much greater importance is Bombay than Bengal in this trade. From 1869-70 down to 1884-85 the exports of raw hemp stood practically stationary, but in the following year

Exports.

* Presumably *sunn* hemp or *sunn* hemp along with a certain amount of the fibre of Hibiscus cannabinus—*sanpát* or *ambádi*.

CROTALARIA juncea. — **Imports and Uses of Sunn-Hemp.**

13 FIBRE, TRADE IN.

they developed to R6,88,825, and last year attained the by no means inconsiderable proportion of R16,41,384 (£164,384). Throughout the whole of that period Bombay continued to furnish from ½ to ⅞ of the total amount exported, and her share last year was valued at R8,80,494, while the Bengal share amounted to R6,72,128. It remains for the future to reveal whether this remarkable advance is due to a turn in the tide of popular favour; but it would seem desirable that no opportunity should be lost in pressing the claims of this fibre. With this object in view, it would be of the greatest practical utility to procure more carefully prepared returns both of the foreign and internal trade, care being taken to separate the quotations of *sunn* hemp from all the other fibres hitherto grouped with it under that most inappropriate and misleading name "Hemp."

Hempen Goods.

In 1866-67 a trade was first reported in exports of Indian Manufactured Hempen Goods other than cordage. This continued to expand until, in 1870-71, when it was valued at R1,64,433, of which Bengal had assigned to it R1,53,330. The bulk of these exports went to the Straits Settlements, Ceylon, and Mauritius. From 1871-72, this trade began, however, to steadily decline, and in 1874-75 was valued at R1,19,327, of which Bengal claimed R1,15,875, and Bombay would appear to have taken no share. Next year these exports fell to R5,299, of which the Bengal portion was valued at R2,500; in 1880-81 they had still further declined to R2,230, but expanded again in 1883-84 to R6,510 (Bengal taking no part in the trade), and last year they amounted to R262 only.

Ropes and Cordage.

The exports consisted chiefly of *sunn* hemp cloth and sacks, and it seems probable that this native industry may have been ruined by the remarkable success of the Bengal jute industry. A difficulty exists in tracing out the extent of the hemp trade in ropes and cordage, both the foreign imports and the Indian exports, since all returns for Ropes and Cordage, of whatever material made, are given collectively.

Imports.

IMPORTS OF HEMP AND HEMPEN GOODS.—It seems probable that the bulk of the raw fibre so reported may be the Manilla hemp used up in the Indian rope factories, and of the hempen goods, canvas and other fabrics of true hemp. This trade is not extensive; last year (1886-87) only 7,641 cwt. of hemp fibre, valued at R1,71,795, was imported, with, in addition, "hemp cloth and sacks" to the value of R43,000. Under the heading of "Government stores" will generally be found an item of canvas as imported (? chiefly flax); last year this was valued at R50,801.

Re-exports.

Of the imports of foreign hempen goods, a small re-export trade is done to other countries, but a very much more extensive shipping trade consists in carrying coastwise Indian hemp (*sunn* hemp)—*e.g.*, from one port of India to another. This is the coasting trade which, along with the rail, river, and road-borne traffic, completes the account of interprovincial dealings. The total value of the imports returned as received at Indian ports from other Indian ports amounted to R7,00,534—a trade which has shown a steady increase since 1882-83, when it was valued at R3,90,850. In another series of tables published by Governmeut are shown the exports of Indian hemp from all Indian ports to other Indian ports, and these are returned as valued at R6,24,303, the trade having steadily increased since 1882-83, when it was valued at R96,087.

USES OF.

USES TO WHICH SUNN HEMP IS PUT.—The chief purpose for which this fibre is utilised at the present day is the manufacture of a coarse cloth (*tát puti*) or canvas used chiefly for sacking.

Canvas.

A large amount of the fibre is annually used up in the native cordage trade, for which it is well adapted, and large quantities of the fibre are also consumed by the European rope-makers in India. The waste tow and old materials are made into paper. It is stated that in Jaipur and in many districts in the North-West Provinces

paper is regularly made of this material, and large quantities are annually used up by the Indian paper-mills. The paper made by the natives of Bombay is principally of *sunn* hemp; 3 parts of *sunn* to one part of cotton is a common mixture. In *Spons' Encyclopædia* occurs the following remark regarding *sunn* paper: "The average weight sustained by slips of sized paper, weighing 39 grs., made from "raw" fibre, was 64lb, as compared with Bank of England note pulp, 47lb. One batch was reported to make a nice, clean, smooth paper, of good colour, but not taking ink well." 13 FIBRE. Paper.

For European purposes the fibre may be used as a substitute for hemp or for flax. Speaking of the special form of the fibre produced in Travancore, Dr. Royle says: "The appearance of this fibre is totally different from any other which comes from India, as it is in the state as if prepared for spinning into thread, and must have been combed or heckled. The fibres are brownish in colour, about 3 to 4 feet in length, clean and shining, not so fine as flax, but still resembling some of the coarser kinds. A very competent judge informed the author that it might be sold for the purposes of flax, or as a kind of flax, and was worth £35 a ton, so some specimens sent to Dundee were valued at the same sum, and it was said could be used for the same purposes as flax, though rather too dry." So, again, "This hemp, when prepared with the patent liquid, became soft, white, and so fine when heckled as to bear the closest comparison with flax at £80 per ton. It is better than any Russian flax for fine spinning. Bombay hemp, rough and dark, and valued at £20 per ton. This article, being similarly prepared, was considered equal in value with the Madras hemp. Hemp & Flax Substitute. Travancore Sunn.

Sunn stalks (after removal of the fibre) are used chiefly as firewood. But of the Kolaba district, Bombay, it is stated: "Hemp torches are made by tying together, in four or five places, about 200 stalks with their fibres, each torch being about three feet long and ten inches round. Hemp matches are also made by Bohorás, who cut each stalk into about six pieces and dip the ends into a *solution of sulphur*." STALKS. Torches. Matches.

Before concluding this account of *sunn* hemp it may be as well to emphasize the fact that all writers agree in pronouncing the fibre obtained from Travancore and that from the Central Provinces (the latter being the fibre most probably of the form known as **Crotalaria tenuifolia**) as superior to the ordinary *sunn* hemp. We possess so little definite knowledge regarding the cultivated forms of the *sunn* plant that it can only be added that perhaps the first and most necessary step to be taken in any effort to increase the *sunn* hemp industry would be to establish the areas under each recognisable form of the plant, and to collect such botanical specimens in flower and fruit as would admit of their careful determination. Were such specimens to be accompanied with samples of the fibre extracted when in flower and again when in fruit, each being prepared according to both the immediate and the deferred process of retting, it would then be possible to inform the commercial authorities where the best *sunn* hemp was to be had, and it might also be found possible to extend the cultivation of the better races of the plant and to encourage the natives to adopt the process of preparation of the fibre which was found the most appropriate. Fibre from C. P. Bengal. Bombay. Madras. N.-W. P. Punjab. Immediate Process. Deferred Process.

It may be added that there are three or four other species of Crotalaria which, whether wild or cultivated, are used for fibre. It is highly probable some of these may prove to be the peculiar *sunn* hemps of certain districts. The brief notes given in the following pages regarding the more common species, it is hoped, may help the reader to recognise these little-known fibre-yielding plants.

CROTALARIA juncea. — **Sunn-Hemp-yielding Plants.**

13
FODDER.
Seeds.

Food and Fodder.—It has already been incidentally remarked that in some parts of India the seeds of this plant are collected and given to cattle. **Roxburgh** says: "This plant—and it is the only one—is also cultivated by the natives of some parts of the Northern Circars to feed their milch-cows with during the dry season. I have found that it is very nourishing, and causes them to give more milk than most other food. It only bears two or three cuttings; after that the plants perish."

MEDICINE.
Seeds.

Medicine.—The seeds are sometimes used medicinally, having the reputation of being useful to purify the blood.

VOL. I.; PART II. (No. 17): 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

MALVACEOUS FIBRES.

Of the very extensive assemblage of Indian fibre-yielding plants few are of greater value than those which belong to the great families—MALVACÆ, STERCULIACEÆ, and TILIACEÆ. Popularly, the bark fibres obtained from these families are spoken of as the bast fibres—their European representative being the *bast* fibre and matting imported from Russia into England, and so largely employed for gardening purposes. The Russian bast or bass is the liber-fibre or the ribbons obtained from the inner layer of the bark of the linden tree (Tilia europœa). The chief peculiarities of this class of fibres, as distinct from other bark fibres, are the arrangement or union of the fibre-bundles into distinct and separable layers, and the frequency of anastomosis between the bundles composing the ribbons or textile-like bands. This anastomosis is, in fact, the great drawback to the employment of such fibres, since, in some cases, it is so complete and intricate as to render it difficult, if not impossible, to resolve the ribbons into the fibre-bundles of which they are composed. On the other hand, all bast-yielding plants possess the property of allowing these ribbons to be easily separated from the bark and the stem—by a process of simple retting in water—the ribbons being thereby also liberated from each other and may be cleaned with the greatest ease. This is due to the fact that the ribbons of liber are held lightly together, and the isolation from the protecting bark is more complete and the liberation from the stem more easy than in most other plants. This peculiarity has been recognised from the earliest times, and ribbons of bast were most probably plaited into mats long before the art of spinning and weaving was thought of. Natural garments and sacks have, from the remotest antiquity, as at the present day, been made by savage races of such fibres. Branches and even trunks of trees of any required thickness are beaten until the whole sheathing bark, with its much anastomosed inner layer of fibre, separates entire from the core of wood. This natural cylinder of fibre is thereafter cleaned of the outer succulent and decomposable bark, when there remains a fabric as intimately woven as any that could be produced by the most complex appliances—a felt consolidated by nature's machinery for vascular formation. Examples of this kind are not uncommon in the STERCULIACEÆ, where the anastomosis is so complete as to render the fibre useless for textile purposes. But the MALVACEÆ, on the one

side, and the TILIACEÆ on the other, are more amenable to the manufacturer's wants than the STERCULIACEÆ, and under these two families some of our best fibres have to be arranged. The one that has attained the highest commercial position is unquestionably *jute*—a Tiliaceous fibre—but the MALVACEÆ possess many fibre-yielding plants of the greatest use to uncivilized man, some of which at least bid fair in a no distant future, to find a distinct place in the commerce of the civilized world. In this connection it may be added that to the MALVACEÆ and STERCULIACEÆ belong the vast majority of the plants that yield cotton and cotton-like fibres. These are often designated flosses, and, unlike the bark fibres, they are not bundles of vessels but are greatly elongated cells. Cotton may thus be defined as a protecting coma of cells attached to the seeds of various species of **Gossypium** (Conf. with No. 19.)

Of the Malvaceous bast fibres the following may be specially mentioned in the alphabetical order of their scientific generic names:—**Abroma, Abutilon, Hibiscus, Malachra, Pavonia, Sida,** and **Urena.** In the present paper it is not proposed to deal with more than three of these, *viz.*, **Hibiscus, Malachra,** and **Sida.**

HIBISCUS, *Medik.*

Definition.—A genus of MALVACEÆ, characterised by having a capsular fruit, 5-celled, and containing kidney-shaped seeds: stamens numerous, the apex of the tube being truncate or 5-toothed: epicalyx of 5 or more bracteoles.

This genus includes some 33 Indian indigenous and a large number of introduced cultivated plants, several of which are of considerable economic value, and nearly all might be utilised for the fibres they contain. **Hibiscus rosa-sinensis** is the familiar shoe-flower (the *jobá*) of the Indian gardens, so named from its large showy flowers being supposed to yield a blacking for leather. There is, perhaps, no other plant so widely distributed in Indian gardens as the shoe-flower, and it is for this reason alluded to here as a good type of the genus. So much confusion exists in the writings of Indian authors regarding the word "Hemp" that it has been deemed desirable to make an effort to establish a more trustworthy mode of expression. It would, indeed, have been to the advantage of Indian commerce at the present day had Dr. Royle's remark on this subject, made nearly half a century ago, been carefully observed. He wrote: "We should avoid calling every new fibre *Hemp*, when one only can properly be so named. In the same way the South-sea Islanders called every new animal they saw a pig, because that was the only one with which they were acquainted." The true hemp of European commerce is of course **Cannabis sativa**, a plant allied to the nettle, but having a leaf deeply cut into the shape of a hand (palmi-partite). The flowers of the hemp plant are small, green, and insignificant-looking—the males appearing on one individual, and the females on another. The Sunn-hemp of Indian commerce, sometimes called Brown-hemp, is **Crotalaria juncea**—a plant that belongs to the pea-family, and has large showy yellow flowers. Bombay-hemp and Deccani-hemp (and also, as sometimes, though incorrectly, called Roselle-hemp—the true Roselle being **Hibiscus Sabdariffa**), are terms often used loosely, but which should, in all probability, be restricted to **Hibiscus cannabinus**, the hemp-leaved **Hibiscus** (*ambári*). In point of foliage this plant closely resembles the true hemp (hence its botanical specific name), but in no other respect. The stems are slightly prickly, as also the sepals, and the flowers are large yellow with a deep purple centre. Any one who has seen a cotton plant in flower, or the common garden shoe-flower, could never for a moment mistake this plant for either *hemp* or *sunn*, and yet the literature of the fibres obtained from these plants is so disfigured through the application to all three of the popular word "hemp," that it is often quite impossible to discover to which an author is alluding. These plants not only differ materially from each other but their fibres are entirely different, and any attempt to sell the one in place of the other would have serious effects on the development of trade. The Ambári is of course a bast fibre, and is thus more nearly allied to jute than to sunn-hemp or to true hemp. The latter is more nearly allied to rhea than to either of the others. Indeed, these three fibre-yielding plants

may be accepted as the types of three of the most important classes of fibres,—the bast fibres, the nettle fibres, and the pea-fibres. Commercially, Sunn-hemp is more nearly allied to flax than to hemp, and, as stated, Bombay-hemp might with more reason be returned as a form of jute than of hemp.

It is to be hoped this distinction will be observed by future writers, and that the word "hemp" may be restricted to **Cannabis sativa**. The reader is referred to the pamphlet on **Cannabis sativa**—hemp—and to that on **Crotalaria juncea**—sunn-hemp—for further particulars regarding these two fibres. These papers, together with the information here published regarding **Hibiscus cannabinus**—Ambari-hemp,—may be accepted as placing on convenient record the most recently ascertained facts regarding the so-called hemp fibres of India. It may be here added that the term Manilla-hemp is given in modern commerce to the fibre of **Musa textilis**, a brief notice regarding which may be found in Part I (No. 1) of the present volume of Selections.

14 HIBISCUS cannabinus.

---

14. Hibiscus cannabinus, *Linn.; Fl. Br. Ind., I., 339.*

The numbers here given refer to the List at pages 167 to 179.

DECCAN-HEMP; AMBARI-HEMP.

Vern.—*Ambári, pátsan, pulu, nálitá* (Conf. with **C. 1861** in the Dictionary), HIND.; *Mesta pát* (*ambya pát*, the leaves, and *chandana*, the plant, according to **Dr. B. Hamilton**), BENG.; *Dare kudrum* (*kudrum* by Hindus of Chutia-Nagpúr), SANTAL; *Kanuriya*, ORISSA; *Kudrum*, BIHAR; *Patsan, pitwa, rattia san* (*tukhm-i-bhang* at DELHI), N.-W. P.; *Shan* (in Jhelam basin), *sankokla, patsan, san-kokra, sinjubárá*, PB.; *Sujjádo* (according to **Stocks**), SIND.; *Ambári* (in CHANDA), C.P.; *Ambári*, BOMB.; *Ambada*, MAR.; *Pulimanji, pulichi, pulichar-kírai, palungu*, TAM.; *Góngúra* (according to **Elliot**), *gaynara* (GODAVERY), *gonkura*, TEL.; *Pundrike gida, holada*, KAN.; *Náli, garnikura*, SANS.; *Sujjádo* (according to **Stocks**), PERS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 528; Voigt, Hort. Sub. Cal., 117; Thwaites, En. Ceylon Pl., 401; Stewart, Pb. Pl., 22; Aitchison, Cat. Pb. and Sind Pl., 20; Drury, Handbook Fl. Ind., I., 71; Campbell's Report on Econ. Prod. Chutia Nagpúr, 17; Fl. Andhr. by Elliot, 61; Rept. Bot. Gardens, Bangalore, by J. Cameron, 24; Roxb., Coromdl. Pl., II., p. 48, t. 190; U. C. Dutt, Mat. Med. Hind., 311; Dymock, Mat. Med. W. Ind., 2nd Ed., 104; H. C. Ker, Cultvn. of, and trade in, Jute, 3, 87, 91; Baden Powell, Pb. Pr., 332; Atkinson, Him. Dist., 709; Drury, U. Pl., 243; Duthie & Fuller, Field and Garden Crops, 86; Lisboa, U. Pl. Bom., 226; Birdwood, Bom. Pr., 316; Royle, Fib. Pl., 254; Liotard, Paper-making Mat., 5, 16, 17, 28, 34; Report on Indian Fibres of Cross, Bevan, King, & Watt, 39; Mueller, Extra-trop. Pl., 158; Manual, Coimbatore Dist., Madras, 238; Manual of Trichinopoly by Moore, 72; Madras Manual, 313, 360; Settlem. Rept., Godavery (C. P.), 36; Settlem. Rept., Chanda, 83; Settlem. Rept., Kangra, 25; Settlem. Rept., Montgomery, 107; Settlem. Rept., Asamghar, N.-W. P., 118; Orissa Gaz., II., 176 and App., VI; Bom. Gaz., XII., 153; Official Rept. of Kumáon by Madden, 280; Spons, Encyclop., 961; Special Volume of Madras Selections on Fibres.*

Habitat.—A small herbaceous shrub, apparently wild, east of the Northern Ghâts, but largely cultivated for its fibre throughout India, the produce being used by the agricultural classes locally. It is more especially cultivated in Chutia Nagpúr, the Central Provinces, Madras, and Bombay, and less abundantly in the North-West Provinces and Oudh and in the Panjáb. **Stewart** says of the Panjáb that the plant is not uncommon on the lower Himálaya, ascending to 3,000 feet in altitude, and **Bellew** reports its existence near Ghazni at about 7,000 feet above the sea.

It will be observed that the vernacular names given to this plant on the western, southern, and central parts of India have a more original character than those in use in Bengal, the North-Western Provinces, and the Panjáb. In the latter areas it is generally compared to Sunn-hemp or to Jute. This fact might be accepted as pointing to its being a native

14 HIBISCUS cannabinus.

of the former rather than of the latter division of India. The plant is chiefly grown for its fibre, but occasionally, as in some parts of Bengal, as a vegetable; and an oil is also said to be expressed from the seeds in Bombay.

Fibre.—This plant yields a soft, white, silky fibre, eminently suitable for the coarser textile purposes to which jute is applied. It is largely grown by the natives of India and employed for agricultural purposes—ropes, strings, and sacks being made of it. Were, however, a demand to be created for this fibre as distinct from that of Sunn-hemp or other fibres, the cultivation of the plant might be indefinitely extended, and with profit to many needy cultivators who are unable to produce either jute or cotton. But so long as there exists the risk of a supply of the fibre being rejected through a purchaser thinking he was ordering Sunn-hemp and had this fibre thrust on him, a healthy trade in the fibre as an article of export is never likely to be developed. It is, therefore, of the first importance that *Ambári* fibre should have its properties independently investigated; and that a place be established for it separate and distinct from all the other fibres with which it has been confused in modern commerce, or for which it has been employed only as an adulterant. **Messrs. Cross, Bevan, and King**, in their table of the Chemical Analysis of Indian Fibres, place **Hibiscus cannabinus** in their second list, which comprises such as are of less textile value, because of lignification, as for example, **Jute, Sida, Abroma, Pavonia**, &c. Under hydrolysis (*e.g.*, boiling in one per cent. caustic soda, Na_2O) for five minutes, they show it to have lost 14·0, and after continued boiling for one hour, 19·5 of its weight, and that under the same treatment, jute lost considerably less, *viz.* (*a*) 13·3, and (*b*) 18·6. Further, that it contains 73·0 of cellulose, in other words, only 3 per cent. less than jute, and in this respect it is a superior fibre to **Kydia calycina** (70·0 per cent.), **Anona squamosa** (62·3), **Hardwickia binata** (63·4), **Sterculia villosa** (36—40), **Bauhinia Vahlii** (61·6), and **Musa paradisiaca** (plantain), 64·6. These chemists contend that the percentage of cellulose is a more trustworthy criterion of fibre merit than any other single feature that can be cited. The facts of hydrolysis and cellulose give, therefore, to this fibre a considerably superior claim to recognition than most of the fibres enumerated above. It falls far short, however, of Sunn-hemp, a fibre that possesses 83·0 per cent. of cellulose, and of **Sida** 83·1 per cent. On being mercerized (*i.e.*, thoroughly wetted in a solution of 33 per cent. Na_2O for one hour), it loses 16·0 per cent. of its weight, and undergoes important chemical and physical changes. The ultimate fibres (the filaments of **Cross, Bevan, and King's** Report) are from 1·5 to 4 mm. in length, that is to say, they are the same length as those of jute (1·5 to 3), from which, indeed, they can with difficulty be distinguished under the microscope either in size or shape.

To compare with **Messrs. Cross, Bevan, and King's** results of chemico-microscopic examination, it may serve a useful purpose to quote here the description of the fibre published in *Spons' Encyclopædia*. "The dimensions of the filaments are:—Length: max., 0·236 in.; min., 0·078 in.; mean, 0·196 in.; diameter: max., 0·00132 in.; min., 0·00056 in.; mean, 0·00084 in. The length of the extracted fibre varies between 5 ft. and 10 ft. The fibre is somewhat stiff and brittle, and though used as a substitute for hemp and jute, it is inferior to both. The breaking strain has been variously stated at 115—190 lbs. It is bright and glossy, but coarse and harsh. It is sold with and as jute, and is employed in Bengal for the purposes of jute, including fishing-nets and paper. Samples of the fibre exposed for two hours to steam at two atmospheres, followed by boiling in water for three hours, and again steamed for four hours, lost only 3·63 per cent. by weight, as against flax, 3·50, Manilla hemp, 6·07, hemp, 6·18 to

14 HIBISCUS cannabinus.

8·44; jute 21·39. The average weight sustained by slips of sized paper weighing 39 gr., made from this fibre, was 71lb, as compared with Bank of England note pulp 47lb. It worked satisfactorily, and took ink well." Under jute in the same work it is stated that—"Slips of sized paper, weighing 39 gr., made from this fibre, bore 60lb., as against Bank of England note pulp, 47lb." And in another passage the measurements of jute filaments are given as max., 0·196 in.; min., 0·057 in.; mean 0·078 in.; diameter: mean, 0·0008 in. "The shortness of the filaments explains their inability to withstand long exposure." According to the method of hydrolysis described in *Spons' Encyclopædia*, the fibre of **Hibiscus cannabinus** is fully six times as durable as jute, whereas by **Cross'** method of hydrolysis it is slightly less durable than jute. Reducing the measurements given by **Cross** to inches so as to admit of comparison with those published in *Spons' Encyclopædia*, the writer in the latter work gives the maximum as 0·08 in. greater, and the minimum 0·02 in. also greater than the measurements obtained by **Cross**. This may be due to some error in the instruments used by the two observers. But should it be found that **Hibiscus** does actually possess longer filaments than jute, this fact should give to it a higher commercial position than it has as yet attained. It could be produced at the same price and be grown over a much wider area, hence some hopes of a greatly extended trade in *Ambári* fibre might be anticipated with the possession of a more thorough knowledge of its properties. In a Report recently issued by the Agri-Horticultural Society of India, on some experiments performed with "**Hibiscus, Abutilon, Sansevieria,** and **Sida**," the Committee came to the conclusion that these fibres possess "no advantages over that of jute." But may it not be said that this conclusion was influenced by local necessities. It might not be of any special advantage to the jute-growers of Bengal to substitute for jute any of the fibres named; but from an imperial point of interest the question suggests itself whether it would not be advantageous for cultivators, in parts of India where jute cannot be grown, to adopt as a substitute or competitor either **Hibiscus, Malachra,** or **Sida**. It might, for example, be suggested that the efforts to cultivate jute in Madras could with advantage be abandoned in favour of **Hibiscus cannabinus**, and that the sacking trade of Bombay might, as once before suggested, be met by the organisation of a new industry in the fibre of **Malachra capitata**. **Sida** seems destined for a higher position than jute has as yet attained.

To turn now from chemico-microscopic examinations to the results of the practical tests performed by **Dr. Roxburgh**. Two specimens of this fibre were experimented on by the Father of Indian Botany, *viz.* (*a*) prepared from plants "cut when in blossom and steeped immediately;" (*b*) "the same cut when the seed was ripe." Of (*a*) a line when dry broke with a weight of 115lb, when wet of 133lb — the wet line gaining a tension represented by 18lb; of (*b*) a dry line broke with 110lb, a wet one with 118lb, gaining a tension of only 7lb by the process. According to these experiments the *Ambári* fibre deteriorates by the plants being allowed to grow beyond the flowering season. With Sunn-hemp (**Crotalaria juncea**), **Abroma augusta**, and several other fibres, the mature or stronger fibres are obtained when the plants are in fruit. Thus comparing with the above figures, a line of Sunn-hemp prepared from plants in flower broke when dry with 130lb, when wet with 185lb, cut while in fruit the dry line broke with 160lb and the wet line with 209lb, the latter gaining in weight 35lb. **Royle** commenting on **Roxburgh's** experiments remarks:—"So in **Dr. Wight's** experiments, the fibre of **Hibiscus cannabinus**, which is sometimes called the jute of Madras, broke with 290lb, when sunn (**Crotalaria juncea**) broke with 404lb. Both these, like **Dr. Roxburgh's** specimens, were probably grown in the same climate. But in the author's

14 HIBISCUS cannabinus.

experiments, Sunn broke with 150lb, when Brown-hemp broke with 190lb; but the Sunn was from Bengal, and the Brown-hemp from Bombay. There is, however, some uncertainty about this, because, though no fibres can well appear more distinct than these two, yet the author has in his possession fibres of a **Crotalaria** which are hardly to be distinguished from **Hibiscus**—Brown-hemp." The Sunn fibre of Bombay was, even in **Dr. Roxburgh's** time, remarkable for its dark colour. But some specimens of Ambári fibre, sent by **Dr. Gibson** as those of **Hibiscus cannabinus**, and which closely resemble those of some kinds of ordinary Brown-hemp, were favourably reported on by a **Mr. Enderby**, then of the rope-manufactory at Greenwich. Brown-hemp is and has always been the peculiarly prepared Sunn-hemp of Bombay, otherwise known as Salsette Hemp. **Roxburgh** gave his own results of experiments with this, and admits that it is distinctly superior to Bengal Sunn-hemp, is of a dark colour, and the fibres more easily heckled because of being peeled off. Far from **Royle's** experiments upsetting therefore the experiments of **Roxburgh** and of **Wight**, they simply prove that **Royle** was comparing Bengal with Bombay Sunn-hemp, and not, as he affirms, Bengal Sunn-hemp with Bombay *Ambári*. **Royle** may thus be viewed as having seriously laid the foundation of much of the confusion in modern literature which has so materially retarded any possible formation and growth both of a Sunn-hemp and an *Ambári*-fibre industry. For Salsette or Brown-hemp the reader is referred to the article **Crotalaria juncea**, No. 16, reprinted in these Selections from the Dictionary of Economic Products.

Dr. Buchanan-Hamilton wrote that the natives of Bhagulpur in his day considered this fibre stronger and more durable than jute. **Mr. Hem Chunder Ker** says that "It is employed in Bengal for all the purposes of jute and also for making fishing nets and paper." In a further paragraph he gives an account of the process adopted in making paper from this fibre with lime—20 seers of fibre to 3 of lime and 20 of water being the proportions used.

METHODS OF CULTIVATION AND SEASONS OF SOWING AND REAPING THE AMBARI-FIBRE PLANT.

BENGAL.

In Bengal.—**Roxburgh**, in his *Flora Indica*, says this plant is cultivated in the rainy season. Most writers affirm that it is grown as a mixed crop, only, forming belts through or along the borders of *dál* fields and other such crops. **Dr. Buchanan-Hamilton** alludes to having observed it cultivated in Bhagulpur nearly as extensively as Jute. In Purniah he found it grown by itself and not as a mixed crop.

NORTH-WESTERN PROVINCES.

In the North-Western Provinces.—**Messrs. Duthie** and **Fuller** admit that it is impossible to arrive at a definite knowledge regarding the extent of cultivation, "but it is believed to be grown on a much smaller scale than Sanai. It is very rarely cultivated as a sole crop and most commonly occurs as a border to fields of sugar-cane, cotton, and indigo." "In ordinary Doab Districts it is only met with as a sparse bordering to some *kharif* fields, and is merely grown for the domestic uses of the cultivator." "Its cultivation will necessarily be similar to that of the crop with which it is associated, and thus it will be sown in February if as a border to sugar-cane, in May if a border to *jamowa* indigo, and in July if a border to cotton. When ripe the plants are cut down close to the ground or are pulled up by the roots. It is important that none of the lower part of the stem be lost, since this contains the best fibre. The stalks are then kept submerged in water for a period varying from six to ten days according to the weather, when the bark can be easily pulled off by hand in long continuous strips. The method of extraction is, therefore, much simpler than that of Sanai. If the stalks are kept too long in water, the fibre loses very greatly in strength, although gaining in colour." The outturn varies between 125 seers and 20 seers an acre according to the thickness of the

14 HIBISCUS cannabinus.

sowings and the degree to which the belts of fibre-plants are overshadowed by the other crop. In the Azamgarh Settlement Report (*p. 118*), it is stated of this plant that "It is grown throughout the district by cultivators of all castes round the edges of their sugar-cane fields. The seed is put into the ground at the beginning of the rains, and the plant is cut in October."

PANJAB.

In the Panjáb.—Stewart writes: "It is generally raised in narrow strips along the deegs of the fields of cotton or pulse, being sown either about April and irrigated up to the rains, or sown during the latter, the former giving much the best result (*Edgeworth*). Its fibre is used for the manufacture of ropes, twine, and sacking. In Sind its fibre is considered the best for nets and ropes, but it is rarely used for cloth."

In the Kangra Settlement Report and also in the Montgomery Report the plant is described as an autumn crop.

BOMBAY.

In Bombay.—Lisboa says: "The fibres of this plant—which are prepared by steeping the stems in water, are hard, and more remarkable for strength than for fineness—might be considerably improved by care. A line made of them, 4 ft. long, sustained, when dry, a weight of 115lb; in the wet state its tenacity was greatly increased, and it bore a strain of 133lb. Is only adapted as a mixture for the commoner description of paper." The *Gazetteer of Bombay* (*Vol XII., 153*) says the plant is sown in June and reaped in October.

MADRAS.

In Madras.—Roxburgh gives in his *Coromandel Plants* a full account of this plant. He says: "The usual time of cultivation is the cold season, though it will thrive pretty well at all times of the year, if it has sufficient moisture. A rich loose soil suits it best. The seeds are sown about as thick as hemp, but generally mixed with some sort of small or dry grain, rendering it necessary to be sown very thin, that the other crop (which is one of those grains that does not grow nearly so high) may not be too much shaded. It requires about three months from the time it is sown, before it is fit to be pulled up for watering, which operation, with the subsequent dressing, is similar to that hereafter described for Crotalaria juncea."

Coimbatore.

The most complete account of the cultivation of this plant which the writer has had the pleasure of reading is that given by Mr. F. A. Nicholson in his Manual of Coimbatore District (*p. 238*). He says:—"*Pulimanji* is grown everywhere in gardens and on dry lands, but especially in red loams and gravels; in the former with various crops, such as turmeric, *ragi*, *kambu*, &c., in the latter with *cholam* and *kambu*. In gardens, as a mixed crop, it is planted on the ridges of the beds and watercourses, not indiscriminately; on dry land the seeds are mixed and sown broadcast. Occasionally it is grown as a separate crop in gardens, and is then sown thickly about two or three inches apart in beds, and watered twice a week.

"The fibre is prepared by bundling the stalks, which, after a few days, are steeped for nearly a week in water under stones; when sufficiently retted they are cleaned by beating them on the ground, the fibre stripped off, washed, and dried. Five hundred stems, about eight feet high, as grown *en masse* in gardens, were recently taken at random and the fibre removed and cleaned in the usual way; the result was 5½lb clean and good fibre. The stems when carefully dried weighed nearly 20lb. Assuming the acre to be 40,000 square feet after allowing for waste patches, the number of stems at three inches apart would be 640,000; hence the yield in clean fibre at 1lb per 100 would be 6,400lb = 2⅞ tons; the stems would yield also 11 tons of poor fuel. The yield of three fine stems grown along the ridges in turmeric plantations, and measuring 16 to 17 feet high, was 3¼ ounces of clean fibre, or somewhat over one ounce each, instead of ⅛th of an ounce. The dried stems each weighed 5 ounces instead of less than ⅝ths of an ounce. The fibre is very well spoken of; in

15 HIBISCUS ficulneus.

Coimbatore. Price.

some experiments it was stronger, in some weaker than sunn-hemp. This fibre appears to offer a splendid field for agencies either for cordage, or more especially for paper stuff; it is grown with the greatest ease and abundance, and on dry land it never fails, though less productive than when grown in gardens. At present, when produced only in small quantities and rudely extracted by hand, it is sold retail, including the ryot's profit, at R1 per 25lb, and could certainly be produced far cheaper by the new machines. Any quantity could be grown to order."

AREA OF CULTIVATION AND TRADE IN AMBÁRI HEMP.—No information other than is conveyed by the above passages can be procured. It, therefore, seems desirable that all future reports on the so-called hemp fibres may deal with that of **Hibiscus cannabinus** separately from the sunn-hemp and the true hemp.

Amounts required for present Collections.

Note.—For the purpose of the collections of fibres for which, in the hope of aiding local officers, the present note has been drawn up, it may be suggested that half a maund of Ambari (**Hibiscus cannabinus**) fibre may be prepared from each of the following regions:—Chutia Nagpur, Madras, and Bombay.

Although it is not proposed to deal fully with all the **Hibiscus** fibres, the following brief notes regarding the two next in merit, after **Hibiscus cannabinus**, may be here given.

[*Ic., t. 154.*

15. Hibiscus ficulneus, *Linn.; Fl. Br. Ind., I., 340; Wight,*

Syn.—H. STRICTUS, *Roxb., Hort. Beng., 52;* H. PROSTRATUS, *Roxb., Fl. Ind.;* ABELMOSCHUS FICULNEUS, *W. & A., Prod., I., 53.*

Vern.—*Ban-dhenras* or *dheras,* BENG.; *Kapasiya,* N.-W. P.; *Dula,* PB.; *Parupu-benda, nella-benda,* TAM.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 527 and 528; Voigt, Hort. Sub. Cal., 119; Thwaites, En. Ceylon Pl., 27; Atkinson, Him. Dist., 701; Royle, Fib. Pl., 260; Cross, Bevan, and King's Report on Indian Fibres, 40; Journ. Agri.-Hort. Soc., New series, VII., 224, 229.*

Habitat.—Indigenous in the hotter parts of India from the Panjáb, North-West Provinces, and Bengal to Madras.

A small, herbaceous, annual bush, which should be sown at the beginning of the rains. Roxburgh recommends a little earlier date for sowing, namely, in a bed in May, the plants being transplanted in rows nine inches apart when about six inches high.

Fibre.—Like most other MALVACEÆ this plant yields a valuable fibre. Roxburgh says: "In none have I found so large a quantity, equally beautiful, long, glossy, white, fine and strong as in this. To these properties may be added the luxuriant growth and habit of the plant, rendering it an object of every care and attention, at least until the real worth of the material is fairly ascertained." Like many of Roxburgh's valuable economic discoveries, this has remained for nearly a century without a single fact having been added or any progress made towards utilising the tons upon tons of valuable fibre lying useless on our waysides. Roxburgh planted 40 square yards in the manner above described, and he obtained "thirty-three pounds weight of the naturally very clean fibres." In his experiments with this fibre he found that a dry line of it broke with a weight of 104lb, and a wet line with 115lb, the fibre having gained 12lb in weight by being wetted.

This was one of the fibres recently experimented with by the Agri-Horticultural Society; and by the Death and Ellwood Machine, they obtained from 20 seers of green stems 2·81 per cent. of clean fibre and 1·41 waste fibre. Commenting on this experiment they say: "Even the *bandhenras,* with its large amount of mucilage, was worked out with the greatest

ease." Mr. Atkinson, in his *Himalayan Districts*, says of this plant that it "affords a very large proportion of strong fibre of a white colour, useful for twine and light cordage."

17 MALACHRA capitata.

Note.—It has been suggested that this plant should be cultivated and a maund of the fibre prepared. It might be further recommended that as the plant is wild on the Rajmahal hills, a certain amount of the fibre might be obtained from that district.

Quantity of Fibre required.

16. Hibiscus tiliaceus, *Linn.; Fl. Br. Ind., 343; Wight, Ic., t. 7.*

Syn.—PARITIUM TILIACEUM, *W. & A.*

Vern.—*Bola, chelwa,* BENG.; *Baniá,* or *bariá,* ORISSA; *Belli-pata,* BOMB.; *Thinban thengben,* BURM.; *Beligobel, bellipattá,* SING.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 522; Kurz, For. Fl. Burm., I. 126; Beddome, Fl. Sylv. Anal. Gen., 14; Thwaites, En. Ceylon Pl., 26; Dals. & Gibs., Bomb. Fl., 17; Irvine, Mat. Med. Patna, 123; Hunter's Orissa, II., 175, App. VI; Lisboa, U. Pl. Bomb., 15, 194, 227; Christy, Com. Pl. and Drugs, VI., 33; Royle, Fib. Pl., 261.*

Habitat.—A much branched bush of the Coasts of India, Burma, and Ceylon. Particularly plentiful in the Sunderbuns, and on the river banks of Burma. The ease with which this plant might be propagated over wide tracts of swampy country, where little else will grow, should afford a powerful incentive to an effort being made to utilise the fibre it affords.

Fibre.—Yields a useful fibre, extensively employed locally for cordage. It is said to gain in strength when tarred. Roxburgh's experiments with this fibre gave the following results:—A line broke when white with a weight of 41lb, after being tanned with 62lb, and after having been tarred with 61lb. A similar line macerated in water for 116 days broke when white with 40lb, tanned 55lb, and tarred 70lb. These observations are of great interest, for, of the other fibres experimented with by Roxburgh, the majority were rotten after maceration and no other fibre showed so marked an improvement for cordage purposes when tarred. English hemp and Indian grown hemp, treated in the same manner, were found to be rotten, and Sunn-hemp broke with 65lb, and Jute with 60lb. The power of endurance under water is, therefore, a point of great importance.

Good Fibre for Cordage.

The fibre is readily separated from the green or unsteeped branches, the work of preparation being less tedious than applies to the other fibre-yielding plants of this genus. It appears to be well adapted for making ropes, mats, and possibly paper (*Cameron*). The fibre seems highly suitable for the paper trade and immense quantities of it might be conveyed in boats to the paper mills of Bengal.

Quantity required.

MALACHRA, *Linn.; Gen. Pl., I., 205.*

17. Malachra capitata, *L.; Fl. Br. Ind., I., 329;* MALVACEÆ.

Vern.—*Ran* or *ban-bhendi,* BOMB.

References.—*Voigt, Hort. Sub. Cal., 112; Dals. & Gibs., Bomb. Fl., 9; Lisboa, U. Pl. Bomb., 227; Livtard, Paper-making Mat., 79, 80, 81; Cross, Bevan, and King, Report on Fibres of India, 54; Proc. Agri-Hort. Soc. Ind., VI., XLVIII.; Spons, Encyclop., 981; Balfour, Cyclop., 804.*

Habitat.—An erect annual, with broad heart-shaped leaves, covered with stiff hairs. The flowers are yellow or white, and form axillary or terminal heads. None of the earlier botanical writers allude to this plant, from which circumstance it is presumed to be a modern introduction. It is a native of west tropical Africa (the Congo basin particularly), and of tropical America. Voigt is the first Indian writer who makes mention of the plant, and in *his* day it would not appear to have been so plentiful as at the present time, since he simply remarks that it is domesticated about

17 MALACHRA capitata.

Serampore. Graham, and after him Dalzell and Gibson, affirm that the plant was introduced into Bombay from Brazil by the late Mr. Nimmo. The plant is now plentiful throughout the hotter damp tracts of India, more especially in the vicinity of Bombay.

Fibre.—It yields a fibre 8 to 9 feet long, with a silvery lustre, and almost as soft as silk.

Dr. King reports that for paper-making this does not seem to promise much; it has, however, been experimented with in Bombay as a substitute for jute and reported on favourably by the manager of a factory. The fibre was shown at the late Colonial and Indian Exhibition, an excellent sample having been presented by Mr. A. B. Gupte. At one time high hopes were entertained that Bombay would in this fibre possess the means of competing with the Bengal jute manufacturers. Just as the growth of the jute industry eclipsed all the other fibres that were half a century ago equally contesting the growing market for a cheap textile, so twenty years later, the immense popularity of the Bombay wheat trade seems to have extinguished the hopes once entertained of this fibre. The reports published regarding it are, however, unanimous, that it is little if at all inferior to jute and that capital directed towards the cultivation and manufacture of the fibre is all that is needed to place the industry on a sound commercial basis. The efforts to introduce the cultivation of jute into Bombay may be pronounced a failure, and there would, therefore, seem every prospect of a new interest being taken in this neglected fibre. The fibre was much admired at the Colonial and Indian Exhibition, and the experts who examined it were of opinion that Bombay would not much longer continue to import the sacking required for her grain trade, and that some enterprising manufacturer would soon be found willing to use this fibre or some other allied fibre in the manufacture of gunnies for the local market. In the hope of usefully placing in the hands of the public existing information the following reprint may be here given.

Notes, &c., on the Experimental Cultivation of **Malachra capitata** *in Bombay.*

Note by the Assistant Secretary to the Government of India in the Department of Revenue, Agriculture, and Commerce, on the new fibrous plant **Malachra capitata**, *dated 15th April 1878.*

Among the specimens of raw produce collected in Bombay for the Paris Exhibition were samples of fibre extracted from **Malachra rotundifolia** (so named in the list of Bombay contributions).

Regarding this specimen, the following remarks were made in a memorandum attached to the list of contributions:

"From this plant, which grows abundantly during the rains in waste places in and near Bombay, Dr. W. Gray, M.B., extracted a fine fibre and sent it to the proprietor of the Bombay Hemp and Jute Mill for examination. It was most favourably reported upon. At the beginning of the last monsoons the proprietor was, at his own request, taken to the Byculla flats in Bombay and the plant was shown to him. He remarked that the usefulness of this plant was not known, and reported that the discovery is 'a boon to Bombay.' He has subsequently taken steps in procuring fibre from this plant, and about forty day-labourers were till now kept working by him at Chembive, a village near Coorla. A new industry has thus been started. This fibre perhaps deserves special attention."

Struck with these remarks, I asked the officer who was in charge of the Bombay collections for Paris, and who had prepared the list (Mr. F. F. Arbuthnot, C.S., Collector of Bombay), to be good enough to furnish me with some further information on the subject and samples of the fibre, as well as of the plant itself. Mr. Arbuthnot was not able to send me any of the fibre, the whole quantity prepared by the mill-owner referred to above after the monsoon having been already exhausted. He has mixed the fibre with jute and made gunny-bags of the mixture. Mr. Arbuthnot sent me samples

17 MALACHRA capitata.

of the plant, however, and copy of a letter from the mill-owner to **Dr. Gray** on the subject of the fibre. The letter was to the following effects:—

". . . . I have received through your friend, Mr. B., a sample of a nicely-cleaned new fibre taken from a jungle plant, and being new it gave me extra pleasure in testing it, and I can safely say that the new fibre is quite as good as jute. If this new fibre can be grown in quantity, it will be a great thing and a boon to this Presidency. The fibre is actually not the yarn of jute, nor do I know its true name. It seems like what the natives call *ranee bhendee*, or jungle *bhendee*; but even that is doubtful, as *bhendee* is scarcely so good as this fibre.

"The fibre is in length from 8 to 9 feet, thoroughly clear from gummy substance and dirt, has a nice silvery appearance with a peculiar lustre, and is almost as soft as silk. In passing the fibre through the machinery, damped with oil and water, as is commonly done with Bengal and Konkan jute, yarn was produced strong enough and nearly equal to that made from the second quality of Bengal jute. In the opinion of our European spinning-master, owing to the almost imperceptible difference between the yarn made from the new substance and Bengal jute, it is very suitable for weft; but if the plant is carefully grown and well looked after, the fibre would then, no doubt, rank fully equal to Bengal and Bombay Jute. Owing to the high prices ruling for jute in Bengal and elsewhere, the new fibre, if carefully prepared, would command a ready sale at R3-12 to R4 per Indian maund." [1]

I submitted the specimens of the plant, and the papers received from Bombay, to **Dr. King**, Superintendent of the Botanical Gardens, Howrah, who had kindly offered to identify and name the plant. He says that the plant is **Malachra capitata**, and not **M. rotundifolia**, which is found only in South America, and he adds—

"**Malachra capitata**, though probably originally a native of South America also, is now found everywhere within the tropics. It now grows sparingly about Calcutta; but, as it is not mentioned by **Roxburgh** in his *Flora Indica*, it appears probable that it did not occur at all here in his time. **Wight** and **Arnot** do not mention it in their *Prodromus Floræ Peninsulæ Indiæ Orientalis*, and it is, therefore, improbable that it was common in Southern India when that book was written. I should not anticipate any difficulty about growing the plant in Bengal; but whether it would yield as good a fibre or be as valuable as jute, I am quite unprepared to offer an opinion. The plant belongs to the new order MALVACEÆ. It is an erect annual (or occasionally perennial) shrub, covered everywhere with very stiff hairs. The leaves are broadly heart-shaped, almost rounded, and are borne on long stalks. The flower-heads are also carried on long cylindrical stalks which rise from the axils of the leaves. The flowers themselves are yellow or white in colour. There are about five or six of them on each head, and they are surrounded at their origin from the flower stalk by three or four half-kidney-shaped bracts. Each flower produces five seeds."

The above is a popular description. **Sir J. D. Hooker's** description in the *Flora of British India* is to the same effect, though stated in botanical terminology. **Sir Joseph Hooker** writes of this plant (**M. capitata**) that it occurs throughout the hotter parts of India from the North-Western Provinces to the Carnatic, probably introduced.

The members of this family are usually found in marshy places within the tropics. It would seem, therefore, that this species would thrive well in Bengal; in fact, it is already common about Calcutta; and **Voigt** (*Hortus Suburbanus Calcuttensis*, page 112) refers to it as domesticated in his time (1841) about Serampore. **Mr. Blechynden** tells me that **Graham**, in his Catalogue of Plants in Bombay and its vicinity, alludes to **Malachra rotundifolia** as introduced by **Mr. Nimmo** about forty years ago.

The preparation of the fibre is the same as that of jute. When **Dr. Gray** operated on the fibre in Bombay, he steeped the stem in water for a week. It must be steeped when freshly cut; for, according to the experience of the mill-owner who tried the fibre, if the stem is exposed to the sun and allowed to dry, great difficulty is felt in getting rid of the external bark, and the fibre obtained is coarse and inferior in quality.

The utilisation of this plant would be specially advantageous in the Bombay Presidency, where as yet attempts made to grow jute can hardly be said to have had any success. But the plant seems to merit attention in Bengal too. Growing as it does and flourishing without any attention in marshy soil, of which we have more than enough for all purposes in Lower Bengal, it would seem to offer the spinners and paper-makers an excellent substitute for, and addition to, jute. I believe the Bally Paper Mill Company are anxious to find some fibrous product capable of conversion into paper at low cost. Here is one to their hand, and I beg to recommend it to their attention, as well as to that of jute-spinners and rope and twine makers.

[1] This letter was dated 20th July 1877.

17 MALACHRA capitata.

In Balfour's *Class Book of Botany* (page 771) it is said that in Panama the leaves of this plant are used as an anthelmintic.

Reports obtained through the Agricultural and Horticultural Society of India, on a sample of the fibre of "Malachra capitata" *prepared in Bombay by* Surgeon-Major W. Gray.

I have no doubt this fibre would prove a good substitute for jute for most purposes to which jute is applied; but it seems rather more harsh, and its spinning qualities should be tested in one of the jute-mills before giving a very decisive opinion. To ascertain whether it would prove economically a substitute for jute, we should require to know the yield of fibre per bigha or acre, and the cost of cultivation and manufacture.

(Signed) S. H. ROBINSON.

This sample is beautifully bright and clean, fair length, and good strength of staple, but somewhat harsh. I doubt if it would make a good warp yarn in itself, but mixed with good jute it would do so. The fibre for spinning is not so valuable as jute; it lacks the forked ends when broken, such as the latter possesses, and partakes of the character of the fibre known as *meshta*, which when broken looks as though it had been cut and left with square ends. Before its value as spinning fibre could be fairly assessed in competition with jute, it would be needful to show cost of production, outturn per *bigha*, &c.

(Signed) W. H. COGSWELL.

Fibre harsh.

(Signed) W. STALKART.

Extract, paragraph 3, of a letter from the Acting Collector of Tanna, No. 3298, dated 24th October 1878.

3. The seed of the Malachra capitata, which formed the subject of correspondence ending with Government Resolution under reference, was sown broadcast during the monsoon just over in *gurcharan* or waste land in Bandora taluka, Salsette, and in certain villages of Bassein and Kalyan talukas, and the result is reported to be a complete failure. This result is apparently attributable to the exceptionally heavy fall of rain, and I would recommend a further trial next season.

The following report was received from the Superintendent of the Victoria Gardens, Bombay, in 1879:—

Not having any seed of the plant in stock, and none being procurable in the bazaar, I gathered a quantity of young plants from the flats, as soon as they appeared after the commencement of the rains, and planted them in regular rows 3 inches apart, with a space of 1½ inches betwixt each plant. The soil was stony and loose, formed of a mixture of decayed *cutchra* and the natural soil of the garden. The plant grew very rapidly, and after three months' growth reached a height of 7 to 8 feet, each stalk perfectly straight, and measuring at the root from ½ to ¾ inch in diameter. After four months' growth the plants were cut down, all leaves, branches, and seeds removed, exposed to the sun for three days, and then steeped in water for five days; they were then removed stalk by stalk, and all the fleshy or pulpy part removed by pressing with the finger and thumb. The outcome is as follows: from a Bengal *bigha*, or an area of 1,600 square yards, fibre (the same as sample sent) can be produced weighing 56o℔. When cultivated during the rains, the plant requires no attention whatever; but it must be grown very close together and not exposed to high winds.

The cost of removing the fleshy matter from the fibre will amount to about ₹3 per *bigha*.

17 MALACHRA capitata.

No. 44, dated Bhadgaon, 26th February 1879.

From—The Superintendent, Khandesh Experimental Farm,

To—The Collector of Khandesh.

As directed in Government Resolution No. 2362 of 8th May 1878 (forwarded under your endorsement No. 2154 of 13th idem), I have the honour to report on the Malachra capitata (*syn.* rotundifolia) as a fibre-producing plant.

2. This species of mallow was introduced into Khandesh presumably at a recent date, although there seems to be no very trustworthy information on the subject. It is known here by the name of *ran bhendee*, and the cultivators are more or less familiar with the quality of its fibres, which they sometimes extract.

3. It is found only in good soil, and makes its appearance soon after the first rain. Its leaves much resemble those of the cotton plants in its young state, and on this account often grows along with that crop for a month or more before being discovered.

4. I have conducted many experiments in the utilisation of this waste fibre as well as in the cultivation of the plant as an ordinary crop. I find that the best fibre is produced from green stems, and they are ready for cutting in the early *kharif* harvest, or in time to admit of a light *rabi* crop being sown afterwards, and that the crop does not exhaust the soil as in the case of *sunn* hemp.

5. The habit of the plant is very peculiar: it throws up in the first place a strong central stem, several feet high, furnished with a few straggling lateral shoots. The best fibre is got from an abundance of radical shoots, which remain procumbent and to a distance of 4 or 5 feet, where the ends become slightly bent upwards to admit of the thorough ripening of the cluster, or head of capsules which contain the seeds of the plant.

6. A bale of this fibre, along with seven other kinds, were forwarded to Government in accordance with the instructions contained in paragraph 8 of the Resolution No. 1881 of 7th July 1874. The whole was sent through the Secretary of State to the Dundee Chamber of Commerce, who merely recorded a general opinion on the whole batch without dealing with the merits of any particular sample.

7. The *ran bhendee* fibre is easily extracted, as the bark contains comparatively little of the gummy substance so common to many others of the fibre-producing plants.

8. Notwithstanding the large number of "miscellaneous fibre" shown at the late Mahiji Exhibition, two of the three prizes offered under this head were awarded to samples of *ran bhendee*.

9. I have had a parcel of the fibre prepared, and await your orders regarding its despatch.

SIDA, *Linn.; Gen. Pl., I., 203, 982.*

20. Sida rhombifolia, *Linn.; Fl. Br. Ind., I., 323;* MALVACEÆ.

Habitat.—A shrubby, very variable, perennial plant, widely distributed throughout the tropical regions of India.

The *Flora of British India* describes five varieties of this plant, reducing to these the forms that were made species by the earlier writers. It seems probable that the fibres afforded by these varieties will not be found of equal merit; and this being so, it would be desirable to have them separately dealt with. To keep this object in view, all future experiments towards the cultivation of Sida, as a source of fibre, should be accompanied with the preservation of botanical specimens dried so as to show the leaves, flowers, and fruits of the plant from which each sample of fibre was obtained. By this means it would be possible to determine the particular variety that had been cultivated. The reports which have for the past half century appeared regarding Sida fibre can alone be explained on the supposition that one sample was the fibre from one variety and another sample from another. For, be it observed, that while the structural peculiarities, which, according to the botanist, would alone warrant specific distinctions, may not be present, yet two forms or conditions of a plant may yield economic products as diversified as it is

20 SIDA rhombifolia.

possible to imagine. This fact has given birth to what is now known as "natural selection,"—accidental or other peculiarities in plants being taken advantage of or fostered and developed by cultivation. It is in fact highly probable that the future of a Sida fibre industry depends largely upon a systematic effort being made to discover the properties of the fibres obtained from each variety, or even from one and the same variety as found in different provinces. The following brief abstract, mainly from the *Flora of British India*, exhibits the varieties of Sida rhombifolia, *Linn.*, as accepted by modern botanists, and it may be found useful at least, if not sufficing, to enable persons who may be induced to cultivate this most promising fibre plant, to recognise the form or forms they may be growing, it will serve as a means of connecting the literature of the subject, since one writer speaks of the fibre of **S. rhombifolia**, another of **S. rhomboidea**, a third of **S. retusa**, &c., &c.

Var. 1.—scabrida, *Wight & Arnott, Prod., 57.*

Whole plant sprinkled with rigid, simple or 2—3 partite hairs; both sides of the leaves green, and not tomentose below. Branches without tubercles under the leaves. Peduncles axillary solitary, a little more than half the length of the leaves, jointed at the base. Carpels bicuspidately awned.

This seems to be a form more particularly plentiful in South India.

Var. 2.—retusa, *Linn.*

Leaves obovate, retuse, hoary beneath, toothed towards the apex: stipules longer than the petiole. Peduncles solitary axillary, equalling the leaves, jointed near the middle. Carpels birostrate with short awns.

This form is fairly widely distributed, being the **S. retusa**, *Willd.*, as in *Roxburgh's Flora Indica* (*Ed. C.B.C., p. 517*), where it is said to be a native of Bengal; the S. retusa of *Dalzell & Gibson's Bombay Flora*, where it is said to be "very common;" the **S. chinensis**, *Retz.*, as in *Roxburgh's Flora Indica* (*l. c.*); and also the **S. philippica**, *DC.*, a form met with on the Coromandel Coast. It is the plant described by **Rheede**, *Hort. Mal., X., 18*; and by **Rumph.**, *Amb., V., t. 19.*

Var. 3.—rhomboidea, *Roxb.; Fl. Ind., Ed. C.B.C., 517.*

A shrubby plant without tubercles on the stem. Leaves rhomboid-lanceolate, serrate, hoary beneath; stipules longer than the petioles. Peduncles more than half the length of the leaves, jointed at the base, usually collected into leafy corymbs at the extremities of the branches. Awns of the capsules very short and inflected.

This is the *Mahábalá* of Sanskrit writers, the *Shwet-barjala* (white *barjala*) of Bengal, and the *Atibala chettu*, TELUGU. It is the **S. rhombifolia**, *Wall.*; the **S. rhomboidea**, *Roxb.*, as in *W. & A., Prod.*; and the **S. orientalis**, *Cav.* Roxburgh says it is a native of Bengal, where it blossoms during the cold season, the flowers opening at noon. It is met with in some parts of Madras, and seems also to be the plant reported on in the *Agri-Hort. Soc. Journal* as affording the fibre which **Major Hannay** sent from Assam. In all probability this form is that which yields the best quality of fibre.

Var. 4.—obovata, *Wall.*

This is a large-leaved form, the broadly obovate leaves measuring 1½ by 2 inches, hoary beneath, and having the apex coarsely toothed, and the base drawn out or cuneate. Peduncles longer than the petiole but shorter than the blade.

20 SIDA rhombifolia. SIDA FIBRE.

Var. 5.—microphylla, *Cav.*

Leaves small, elliptic dentate, hoary beneath. Peduncle slightly exceeding the petiole. Carpels 5—7 awned.

This is the plant described by Roxburgh (*Fl. Ind., Ed. C.B.C., 515*), which, he says, is a native of Bengal, in flower the whole year round.

Var. 6 rhombifolia.—To these five forms must be added the condition which would answer to the type of the species—the **Sida rhombifolia,** *Willd.*, as in Roxburgh's *Fl. Ind., Ed. C.B.C., 517*—the *Lal-bariala* (or red *bariala*) or *berela* of Bengal, and the *Átibalá* of Sanskrit. This, Roxburgh states, is a native of Bengal, and flowers during the rainy season. **Aitchison** mentions it as met with in the Panjáb.

SIDA FIBRE.

It seems probable that the fibre experimented with in Bengal has been mostly obtained from the last mentioned, and also from the third variety (**rhomboidea**). These, therefore, had better receive the first attention, as they will most likely be found to contain the best fibre. But the utilisation of **Sida** will mainly depend on the particular form that will produce the tallest stems with the fewest branches, and the highest percentage of fibre to weight of stems. It may readily be admitted that the feature, on which the industry will fail to be established, will be the yield as compared with jute. Hitherto the few Reports that have appeared exhibit the yield as considerably lower than that of jute. Experimenters should, however, not be too easily disheartened on this score, for it must be borne in mind that **Sida** has never been systematically cultivated, while everything has been done that is possible, to improve the yield and quality of jute. A few years' cultivation may result in the production of a **Sida** stock that would give a nearer approximation than has as yet been attained to that of jute; and the fibre will most certainly fetch a considerably higher price than its rival. The claims of **Sida** fibre do not rest on the statements of one observer, more than its rejection should depend on the results of one experiment such as that recently reported on by the Agri-Horticultural Society of India, *viz.*, that it possesses, like **Hibiscus, Abutilon,** and **Sansevieria** "no advantage over that of jute." That opinion is probably so far correct; but it is more to the verdict of the flax than the jute manufacturer that we have to look, since everything points towards the new fibre entering the higher textile markets for which jute is quite unsuited. To make gunny bags of **Sida** would, indeed, be an extravagance, and since jute serves that purpose sufficiently well, there would be nothing gained by disturbing the Bengal cultivators in order that **Sida** might be used as a jute substitute. **Sida** may, however, like **Hibiscus cannabinus,** be grown over a wide area where jute cultivation is impossible. The flax manufacturers of Europe admit that the time has come when they must seek for flax substitutes. In the opinion of many experts no fibre of modern times affords better hopes of success than **Sida,** and the matter may therefore be earnestly recommended to the attention of Government as one well worthy of the expenditure of a little money in the experiments here suggested, namely, (*a*) to definitely determine which form of **Sida** yields the best fibre; (*b*) where that can be most successfully grown; (*c*) the present yield per acre; (*d*) the price at which the fibre could now be put into the market; and (*e*) to continue the experiments further in order to ascertain whether or not the fibre-yielding property of the selected stock could be improved.

In order to justify these recommendations an abstract of existing literature of this subject may be here given. The first person who commercially drew attention to this fibre was **Major Hannay** of Assam. His

20 SIDA rhombifolia SIDA FIBRES,

action followed a few years after **Dr. Roxburgh** had described the various species of **Sida**, in which he remarked, under **S. rhombifolia**, that "the bark of this and the last (**rhomboidea**) yields abundance of very delicate flaxy fibres, and I think might be advantageously employed for many purposes. When the seed is sown thick on a good soil, the plants grow tall and slender, without branching, and in every way fit for such purposes." **Roxburgh** would thus appear to have cultivated these plants; but in the report of his fibre experiments he nowhere alludes to his results in testing the strength and endurance of the fibres obtained from them such as he published with most other Indian fibres. **Major Hannay's** observations seem to have been perfectly spontaneous, and it was only after his fibre had been communicated to the Agri-Horticultural Society that it was discovered to be obtained from **Sida**. The following report on **Major Hannay's** Assam fibre will be read with interest and not unconnected with astonishment that the subject of it should have remained so many years in abeyance. "This fibre very much resembles our best dressed jute." "It is very attractive in its appearance. Its silvery bright and clear colour, its great cleanliness, and its excellent condition, are well exhibited—much better, indeed, than usually belongs to the great bulk of the jute which is exported to Europe, and hence might, for such reasons, obtain some preferable consideration." "After testing the strength of this fibre, and ascertaining its indestructibility by water, I am convinced it is not jute, but I am not prepared to give it a name. But I think from the length of the staple, its similarity to silk, and its great strength, that it would fetch a high price in England. The line (only half an inch in circumference) sustained, after exposure to wet and sun for ten days, 400lb." (*Journal Agri.-Hort. Soc., Vol. VIII. (old series) 1854, p. 62.*) In the subsequent volume, the members of the Agri-Horticultural Society had their attention again directed to this fibre. **Major Hannay**, in 1853, sent seed of the plant from which his fibre was obtained. The plant was cultivated in the Society's garden and a report published. "I have now," **Mr. Joseph Willis** wrote, "to report on the specimen from our gardener **Mr. McMurray's** growth and preparation. I find it of excellent length, being about ten feet. It is very completely freed from all ligneous adherents, and is in excellent condition, having its silvery brightness or lustre and colour in high perfection. The fibre is remarkably round; it is also fine, being somewhat coarser at the root end than in the upper parts, and near the top extremity it becomes exceedingly fine. The strength, although inferior to some of the best or *strong* fibres, which have been before us, is nevertheless excellent. I consider this fibre worthy of the best attention of those who may be engaged in vegetable fibrous productions, and more especially so, as it seems capable of being grown so well in Lower Bengal." **Mr. Haworth**, another high authority, recommended the fibre to be tried on jute machinery, and with this object a sample was sent to the Chamber of Commerce, Dundee, and another to **Messrs. Marshall & Co.** of Leeds. In the IXth. Vol. of the Agri-Horticultural Society's Journal (quoted above) **Mr. McMurray** gives particulars regarding the method of cultivation adopted by him. The seed was sown broadcast on the 16th May and the crop cut in September. The stems were covered over by grass rubbish to cause fermentation, which took place in four days, and they were afterwards steeped for twelve days. The fibre was then cleaned by the same method as is pursued with jute.

Shortly after the date of these experiments, the Calcutta fibre merchants had their attention forcibly directed towards the establishment in India of jute mills in opposition to those in Dundee for which they had formerly been contented to supply the fibre. **Major Hannay's** dicovery was thus lost sight of for nearly 40 years, until in 1880 the Bengal Government drew the attention of the Society to the subject of the *burriala*

20 SIDA rhombifolia. SIDA FIBRES.

fibre—the fibre of **Sida rhomboidea.** The samples of fibre then communicated by the Government to the Society had been furnished by Rajah **Kristendro Roy** of Balihar, in the district of Rajshaye. These were reported on by **Mr. Cogswell** (Journal, Vol., VI., new series, 224) who stated that none of the samples had been steeped long enough. He recommended that long stems should be steeped for seven to ten days, and added: "A large sample should be prepared, and I will get it tested in one of the jute mills, to see what percentage of warp yarn can be spun from it, and a correct value shall be arrived at. There is much in these samples of a soft, bright, glossy, clean fibre, but it is very short in comparison with jute, barely half its length, the value being very materially reduced in consequence."

As a result of this report fresh samples of the fibre were prepared by the Rajah, and these **Mr. Cogswell** considered had been oversteeped, and thereby considerably injured. But he states: "To a few, even experienced men, this fibre might be mistaken for that of fine jute, though not one-fourth of its average length, when deprived of the root ends, as this has been. Its colour is glossy bright in the extreme, and of a very high order. The fibre is strong, fine, round, and of excellent spinning properties, and is well suited for the finest yarns of jute manufacturers; some of it is so silky, as to render it in my opinion fit for higher purposes. I value it at about R4-8 or R4-12 per bazar maund. I think the flax manufacturers at home would be ready consumers of it."

It is perhaps as well to point out in this connection that by length of fibre in the above Reports, **Mr. Cogswell** necessarily means length of the fibre ribbons and not of the ultimate filaments. Cotton, for example, would be a worthless fibre if fibres 10, 15, and 20 feet long were required by all manufacturers. The length of the ultimate filaments and their adhesions are in fact far more important points to the manufacturer of the higher textiles than the length of ribbons composed of such filaments, since the bleaching, carding, and spinning into fine yarn is consequent on the degree to which the ribbons can be broken up. It is noteworthy that **Mr. Cogswell** recognises that **Sida** fibre is "fit for higher purposes" than jute, and that he very properly recommends it to the consideration of flax not jute manufacturers. There are few higher practical authorities on fibres than **Mr. Cogswell**, and this testimony would seem therefore to require only to be published in Europe for encouraging demands to be made on the resources of the enlightened native gentleman who is the modern pioneer of this much-neglected fibre. Recently, however, in order to test the fibre-extracting machines sent in competition for the Government reward, **Sida** fibre, along with several others, has been reported on, and the discouraging statement made that it possesses "no advantage over that of jute." To prevent this opinion which seems to have been formed on a provincial more than an imperial stand-point, in other words, a jute manufacturer's stand-point, from injuring the prospects of the **Sida** fibre industry, and thereby deterring flax spinners and others from giving their attention to this subject, it appears desirable to reproduce here the recent report published by **Messrs. Cross, Bevan, and King,** in which a chemical and microscopic comparison is drawn between **Sida** and Jute.

These distinguished chemists say: "Although closely similar to jute in structure and general chemical characteristics, it is in appearance a superior fibre; it is softer to the touch, and in all respects more uniform. This superiority, moreover, is confirmed by comparative chemical investigation, to show which we reproduce side by side analytical numbers obtained for the two fibres:—

	Jute.	Sida.
Moisture	10·3	10·7
Ash	1·2	0·6

20 SIDA rhombifolia. SIDA FIBRES.

	Jute.	Sida.
Hydrolysis (*a*)	15·0	6·6
„ (*b*)	18·0	12·2
Cellulose	75·0	83·0
Mercerising	16·0	6·6
Nitration	125·0	137·0
Acid purification	1·0	0·3
Carbon percentage	46·5	45·0

"In the relatively high percentage of cellulose we have the most important factor of superiority. It is interesting to note the correlations with this cardinal point of difference of all other qualities determined. This fibre is undoubtedly worthy of extended investigation by practical men."

In conclusion it may safely be said that if Chemistry can be trusted to indicate the properties of a fibre, Sida is unquestionably an infinitely superior fibre to jute. Under hydrolysis (or bleaching and cleaning with an alkali) it loses a very much smaller proportion of its weight, is therefore less easily disintegrated by the action of water, and is consequently much more durable. Similarly, it loses less under the acid purification, and by nitration obtains a considerably greater weight, while it possesses a much larger percentage of cellulose. A fibre with such properties to recommend it is surely worthy of the time and expenditure necessary to ascertain whether or not all these advantages are financially counterbalanced by a less acreage yield.

Quantity required.

NOTE.—Although the only large sample of this fibre that has as yet been produced was raised in Eastern Bengal, it seems highly probable that South India or Bombay would prove better suited than the damper regions of Bengal for the development of a Sida industry. For the purpose of the present collections the supply recommended (p. 174) to be procured from Bengal would suffice, but the attention of Government might with advantage be directed to the desirability of having the experiments here indicated performed in more localities than one.

GEORGE WATT,
Reporter on Economic Products.

Simla, November 1888.

VOL I.; PART II. (No. 18); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

Rhea and Allied Rhea Fibres.

Under the above designation, has, for convenience, been included a brief notice of the fibres of Rhea proper and of China-grass; of **Maoutia Puya** (the *Poi*), and **Villebrunea integrifolia** (the *Ban-rhea*) of Assam; and of **Marsdenia tenacissima** (Rajmahal-hemp). The last-mentioned fibre plant has been associated with the Rheas not because of botanical, chemical, or microscopic resemblances, but because of its great strength—the fibre being, like Rhea, remarkably fine and silvery, and at the same time immensely strong, even stronger than Rhea itself.

Bœhmeria nivea, *Hook. & Am.: Dictionary of the Economic Products of India*, Vol. I., B. No. 576; *Fl. Br. Ind.*, *V.*, 576.

RHEA. China-grass.

This in all probability is the true China-grass, while the plant named **Urtica tenacissima**, *Roxb.*, which by modern botanists has been reduced to a variety of **B. nivea** under the name **candicans**, *Wedd.*, is the Rhea of Assam, and the Ramie of the Straits. But it would appear that the Rhea is also met with in some parts of China.

Rhea Patents.—Since the writer published the brief account of Rhea fibre given in the *Dictionary of the Economic Products of India*, very little of a startlingly new nature has been brought to light. The development of this fibre has progressed slowly and steadily more than been the subject of any violent evolution. At the same time a comparison of the present position of the Rhea industry with that attained twenty years ago or even half or quarter that period will reveal how wonderfully the public attention has been directed to the subject. The annals of the Patent Offices of Great Britain, France, the United States, and of India have been crowded with the registration of processes and appliances, each improving, or claiming to have improved, the methods formerly in use for separating,

NOTE.—This account of the Rhea and Allied Rhea Plants was in type prior to the receipt of Part XV. of Hooker's *Flora of British India*. To bring it abreast of the most recent botanical work on these plants, notes and references have as far as possible been added.—[ED.]

PATENTS.

cleaning, and utilising the fibre. Appliances and machines have been invented to (*a*) decorticate the twigs into ribbons of bark containing the fibre; (*b*) to separate the fibre from the ribbons of dry bark; (*c*) to clean and de-gum the fibre; and (*d*) to spin and weave it into yarns, ropes, and textiles. By some of these patents it is contended that good results can be obtained only with the green twigs, by others that the dry twigs are equally utilisable. The increased freight, however, in carrying to a distant manufacturing centre the contained useless wood of the twigs, has brought into existence special decorticating appliances to be used locally. In some patents, retting has been recommended, in others condemned; and both chemical and mechanical methods of decortication have each been stoutly defended. Dried ribbons of bark have been prepared in the neighbourhood of cultivation and shipped to the manufacturer to undergo the further treatment—separation and purification of the fibre. Perhaps, however, the best modern advance has been the combination of decortication and cleaning in one and the same operation. The justification of this rests on the economy effected, and on the theory that the inner layers of fibre are finer and hence more easily injured by chemical reagents, that they also contain less gum than the outer, and hence the treatment of ribbons or thongs of bark would be accompanied by injurious effects on certain proportions of the fibre. On the other hand, the chemical and miscroscopic examinations accomplished by some of the French experts might be viewed as throwing a degree of doubt on the statement that a heavier deposit of gum exists on the outer than the inner layers of fibre.

(Conf. with pp. 306 & 310.)

Resting satisfied with this brief review as indicating some of the chief features of the keen competition in Rhea patents, it may be said that by whatever means the fibre is separated, Rhea has now practically attained a recognised commercial position. The supposed insurmountable difficulties, which all early writers dwelt on, have virtually disappeared, and it is customary to have thrust into one's hands, as proof of the merits of this process and that, samples of a beautiful silvery-white rhea fibre, of yarns spun from it, and of table-cloths, curtains, and other such textiles woven of this admirable fibre. The writer has had the pleasure to examine several such samples, in the files of correspondence conducted by the Revenue and Agricultural Department. But in preparing the present number of the Selections from the Records of the Government of India, he has been compelled to issue an abstract only of a few of the more notable papers drawn from the voluminous materials placed at his disposal.

FORMS OF RHEA.

Two Commercial Forms of Bœhmeria.—A point of great importance may be here reiterated since upon its full appreciation, it would seem, largely depends the future possible expansion of Rhea as an agricultural crop in India. Doubt has been thrown on the identification of the Rhea or Ramie of India being the grass-cloth of China. This position has been maintained by practical men; botanists regard the two as at most cultivated forms of one species. From an economic point of view it is of little consequence whether the differences amount to specific distinctions, or justify the formation of varieties under one species, or can alone be admitted as establishing cultivated races. The point of importance, from the view it is here desired to uphold, is therefore—whether or not there are superior and inferior qualities of fibre obtained from plants all designated Rhea, China-grass or **Bœhmeria nivea**, or any other collective appellation. Further, whether these plants can or cannot be all cultivated under the same conditions of soil and climate; in other words, whether a form exists that would give in India better results than have hitherto been obtained with the so-called Rhea of the major portion of past experiments. The writer became aware of the possibility of a mistake in the identification of Rhea while preparing the account of **Bœhmeria nivea** as given in the *Diction-*

Rhea is grown in Eastern Bengal, China-grass in Kangra in Madras.

ary of Economic Products. The opening sentence or two of that article may be here reproduced :—" Kurz regards the *Ban-rhea* of Assam as the China-grass cloth which would thus be quite distinct from the Rhea fibre proper. If this be correct we have in India been trying to produce from the wrong plant a fibre to compete with the Chinese grass-cloth. This might account for the fact that the samples of Indian Rhea fibre exported to Europe have uniformly been pronounced inferior to the China fibre. It seems highly desirable that the grass-cloth of China should be carefully looked into with the object of confirming the opinion which generally prevails that it is obtained from the same species as the Rhea fibre of India." Then again **Dr. Roxburgh**, without apparently being aware of the existence of Rhea in Assam and parts of Bengal, and of the fact that it was being cultivated and used by the natives there, procured from Sumatra in 1803 four plants of the Caloce (or Caluse) and planted these in the Botanic Gardens, Calcutta. He gave the plant thus obtained the name of **Urtica tenacissima.** His stock grew and multiplied so rapidly that shortly after he had several thousand plants. About this time the discovery was made by **Dr. Buchanan Hamilton** (in 1810) that the *konkura* or *kankhura* of Rungpore and Dinagepore was identical with the plants **Dr. Roxburgh** was cultivating." In the *Journal of the Agri-Hort. Society of India* [Vol. VI. (Old Series), p. 30] will be found a description by **Dr. Campbell** of the method of cultivation as practised in Rungpore.

FORMS OF RHEA.

(Conf. with p. 318.)

The description given by **Roxburgh** of his **Urtica tenacissima** was most probably taken, however, from the imported Malay stock and not from the Indian plant. In this connection **Roxburgh's** Report to the Board of Trade (1809), on the introduction of the *Calúe* into India may be read with interest. It is reproduced in the *Jour. Agri-Hort. Soc. Ind.* [Vol. VI. (Old Series), p. 181]. In that paper will also be found a reference to **Major Jenkins'** discovery of the plant in Cachar in the year 1833 and to **Colonel Burney's** discovery of it in the Shan provinces of Pevela and Youkzouk which are distant from Ava seven or eight days' journey. **Major Macfarquhar** wrote (1836) that it was cultivated by the Shans, Siamese, and the Chinese, "the latter, with whom I have spoken on the subject, are loud in its praise for its fineness of texture and durability both as cloth and cordage." **Major Hannay** and **Major Jenkins** lay stress on the fact that Rhea is a cultivated plant and *ban-rhea* a wild plant, and neither of these early observers seems to have observed Rhea except under cultivation. But to continue the quotations from the dictionary. "A few specimens from Assam were sent to the Agri-Horticultural Society of Calcutta, and from cuttings thus obtained plants were grown in the Society's garden. From this date (1840) the Society received contributions from several writers, from time to time, giving new facts regarding the growth and preparation of the fibre in Northern India. **Dr. McGowan** furnished information and samples from China, and **Dr. Falconer** and afterwards **Sir William Hooker** identified Rhea as the same plant from which the Chinese grass-cloth is prepared."

(Conf. with p. 299.)

It is worth recollecting in this connection that from **Roxburgh's** Malay stock, the introduced plant was being rapidly distributed all over India, and this being so, doubt may be admitted as justifiable as to whether the introduced or the indigenous plant was sent to Europe for determination. Indeed, it is just possible that the true China-grass plant may have, long anterior even to **Roxburgh's** day, been introduced into India. At all events in his account of **U. tenacissima, Roxburgh** maintains that it is a perfectly distinct plant from **U. nivea** as described by **Louriero.** The word "Rhea," though used in Assam, is questionably of Indian origin. One of the dominant races on the eastern frontier of India and in the valley of the Brahmaputra, by successive waves of conquest, came from Siam. May not these people have brought the Rhea and its name to the

FORMS OF RHEA.

country of their adoption? In part support of this suggestion it may be added that although species of **Bœhmeria** are met with all over India, it is among the invaders of Assam that the fibre is mainly used for textile purposes. That **B. nivea** and **B. tenacissima** are both found in certain parts of India, at the present day, goes without saying, and therefore the Indian samples identified by the early botanists may have been China-grass and not Rhea. Indeed, **M. A. deCandolle** (*Origin Cultiv. Pl., p. 146*) goes so far as to doubt the existence of **B. tenacissima** as a truly wild plant in India, and the last number of the *Flora of British India* (just to hand) treats it as an introduced plant. Speaking of the writings of authors on Rhea and China-grass **deCandolle** says: "We must not trust the vague expressions of most authors," nor put faith in "the labels attached to the specimens in herbaria, since frequently no distinction has been made between cultivated, naturalized, or truly wild plants, and the two varieties of **Bœhmeria nivea** (**Urtica nivea**, *Linn.*, and **B. tenacissima**, *Gaud.*, or **B. candicans**, *Kussk.*) have been confounded together; forms which appear to be varieties of the same species, because transitions between them have been observed by botanists. There is also a sub-variety, with leaves green on both sides, cultivated by Americans and by **M. deMalartic** in the south of France." **M. deCandolle** then proceeds to show that, according to **Linnæus, B. nivea** is most probably only a cultivated plant in China, but that according to many authors it is an abundant wild plant in Cochin-China, in Hong-Kong, in the Philippine Islands, and in the Malay Archipelago. He then adds: "The other varieties have nowhere been found wild, which supports the theory that they are only the result of cultivation" (*Orig. Cult. Pl., 147*). The wild rhea of Assam may therefore not be Rhea at all. (Conf. with the remarks below under **Villebrunea**, p. 316.)

(Conf. with p. 305.

In the *Dictionary of the Economic Products* stress has been laid on the fact that Indian Rhea always fetches a lower price in the market than China-grass. "It is remarkable that the Chinese grass-cloth should be much finer than Rhea; that on being boiled it should lose only 0·89, while Rhea under the same treatment parts with 1·51 of its weight. These and other facts, in addition to the pronounced superior quality of, and therefore higher price paid for, China grass-cloth as compared with Rhea, would seem to confirm the suspicion that these two fibres may after all be obtained from different plants. This remark is made purely as a suggestion, but it seems highly desirable that we should thoroughly examine all the plants met with in India which afford Rhea-like fibres, as well as re-examine the plant from which the Chinese grass-cloth is obtained, before much more money be spent on experiments with new machinery." (*Vol. I., p. 481.*)

There would be nothing remarkable in assuming that in the vast area of China, possessing like India every gradation in climate and soil, tropic and temperate, upland and plain, there should exist many forms of the Asiatic genus, **Bœhmeria**. Forty years ago, **M. Decaisne** (the most distinguished French botanist of his day) cultivated in Paris the China-grass brought from the Celestial Empire by **M. Leclancher**, and having carefully examined the living plants came to the conclusion that they represented two readily distinguishable species. These he designated **Urtica nivea** and **U. utilis**,—the latter was the **U. tenacissima** of **Roxburgh**, a tropical plant, while **U. nivea** is temperate. The subject of Rhea or China-grass for some time after the date of **M. Decaisne's** report lagged in popular favour, and when it was reawakened the two plants were treated as one and the same. To this day the utmost that botanists have consented to, is to assign **U. (Bœhmeria) tenacissima** the rank of a variety under **B. nivea**. Structurally the differences do not appear to be very great, but the temperate plant (**B. nivea**) is generally viewed popularly as recognisable from the tropical (**B. tenacissima**) by having silvery

Tropical form.

Temperate form. (Conf. with pp. 305, 307.)

white under-surfaces to its leaves instead of being green with white veins.* If these be the only differences, it must be admitted that the botanical position is unassailable, but from a practical point of view it would be fatal to force the cultivation of a tropical form of a species in a temperate region or of a temperate in a tropical. It is true, however, that both these plants have shown a sufficient power of adaptation to at first sight permit of this being disregarded at least to some extent. But the experience of European cultivators is to assign **B. nivea** to the more northern and colder areas and **B. tenacissima** to the more southern and warmer tracts of the Continent of Europe. According to most writers **B. nivea** has also been found best suited to America. In India, it would appear that we have disregarded these eminently practical considerations, and it is, therefore, probably safe to say that some share of our failure is attributable to our negligence in not experimentally discovering which form or forms of Rhea or China-grass were suitable to each area before extensive cultivation was undertaken. But even had the distinction between the above commercial forms of **Bœhmeria** been observed we should, in India, have still erred, since there can be little room for doubt that there exist in this country numerous other plants generically treated as Rhea, the claims of which to independent recognition have never been considered.

FORMS OF RHEA.

(Conf. with pp. 316 to 320.)

Among the records of the Government of India there occurs a correspondence accompanied with a copy of **M. Favier's** *Textile Nettles*. A passage from that useful publication may be here given, since it records the results of the French efforts to cultivate the two commercial forms of **Bœhmeria**:—

CULTIVATION OF THE TWO FORMS.

"**Yield.**—The textile nettles cultivated in France must not be expected to grow with the same strength of vegetation which they possess in tropical countries, under the double influence of heat and moisture. These plants, therefore, only give two crops in our country, the first towards the 15th of July and the second towards the end of October or the beginning of November. In order to obtain fibre of uniform quality from both crops it is necessary that the stems of the two crops should come to exactly the same degree of maturity. It is well therefore to hasten the growth of the first crop by means of liquid manures, especially if the spring has been cold, so that it may be gathered about the middle of July; this will give time to obtain the second crop in satisfactory condition.

"According to the calculations of **Mr. Hardy**, ex-Director of the Botanical Gardens near Algiers, a field of textile nettles over a year old, whose stems had reached a height of about six feet, would produce 48,000lb per acre of green stems with their leaves. In that weight there would be 20,400lb of leaves, and 27,600lb of stems, which would be reduced to 4,900lb in drying, and would give 1,400lb of fibrous thongs. **Mr. Hardy** admits that two such crops may be had in Algeria, which would raise the yield of an acre to 9,800lb of dry stems and 2,800lb of useful fibres. Under these circumstances the cultivation of textile nettles would be extremely remunerative.

"We must acknowledge that in France such great crops have not generally been obtained. We find in a very interesting pamphlet on the Ramia, published in 1877 by **Monsieur Goncet de Mas**, exact statements of the results which he obtained in his trials of the culture of this plant. **Monsieur Goncet de Mas** grows the Ramia in the neighbourhood of Padua, in similar conditions of climate to those of the south of France, and the figures which he gives seem to correspond with the results to be expected from the cultivation of textile nettles in our southern departments.

"The first year, according to his own report, he obtained 14,400lb of green stems per acre in two crops, of which weight one half was composed of leaves. The 7,200lb of green stems without leaves yielded 1,440lb of dry stems and 320lb of filament.

"The second year he gathered 52,600lb of stems including leaves, *viz.*, 26,300lb of green stems without leaves, 5,260lb of dry stems, and 944lb of filament.

"The third year, the field being in its definite state, and the plants three feet apart in both directions, but joined by their shoots and roots, he gathered in two crops; 64,720lb of green stems with their leaves (which correspond to 32,360lb of stems without leaves), 6,400lb of dry stems, and 1,280lb of filament.

Yield per acre (Conf. with p. 295.)

* **Hooker** says: "**Weddell** distinguishes as **B. candicans** the form under this name" (**B. nivea**), "and that of **tenacissima** by the more robust habit, larger, longer-petioled concolorous leaves" (*Fl. Br. Ind., V.*, 577). (Conf. with p 308).

FORMS OF RHEA.

"Other agriculturists have obtained in the south of France as high as 1,600lb of filament per acre. It may therefore be admitted that the Ramia, in conditions which may be considered normal in our country, will yield from 1,280 to 1,600lb of filament in two crops per annum, so that each cutting will yield more filament than the best annual crop of hemp or flax.

"The figures which we have just quoted refer to the **Urtica utilis** or *Ramia*. **Monsieur Goncet de Mas** thinks that the **Urtica nivea** or Chinese White Nettle would yield about a third less. This being the case, the cultivation of this nettle would still be very remunerative in the regions where it is not possible to grow the Ramia.

Price. (Conf. with p. 298.)

"As to the price which may be obtained for the filament of the textile Nettles, this must evidently vary according to its quality and condition, but we think it must at least be equal to that of Hârl in the same conditions of preparation and quality. The present value in London of the China-grass filament, imported from India and China, is from £45 to £50 per ton.

"A point to which we must call the attention of agriculturists is that the textile Nettles do not bring forth their full product until the third year of their cultivation. It is only when all the subsoil of the field is permeated with their roots that these plants throw out numerous shoots and yield the quantity of stems above stated."

The best form of **B. nivea**, according to many writers, is that known as **sanguinea**, a name given by **Hasskarl** owing to the red colour of the mature stems. There are doubtless, however, many forms both of **nivea** and **tenacissima**, and the intending planter would do well to procure and experiment on a small scale first with as many forms as can possibly be obtained in order to discover which of them yields the maximum of superior fibre under the conditions of soil and climate peculiar to his estate. Indeed, the Saharanpur failures would point to the by no means improbable result of such experiments proving that in this district no form of Rhea or China-grass is ever likely to become a commercial success.

RELATIVE MERITS OF CHINA-GRASS AND RHEA.—**Dr. Forbes Watson's** figures of loss of weight on boiling these two fibres under a high pressure have already been quoted. The markedly different hydrolysis of the two fibres points to their being distinct,* but this has been established more conclusively by **Muspratt** (*Theoretische un Peaktische Chemie, 1880*) in his comparative chemical analysis of a sample of the Chinese and the Indian fibre.

CHEMISTRY OF THE TWO FORMS.

(Conf. with p. 307.)

	Chinese Nettle.	Ramia.
Ashes	2·87	5·63
Water	9·05	10·15
Matters soluble in water	6·47	10·31
Wax and fatty matter	0·21	0·59
Cellulose	78·07	66·22
Intercellular substance	6·10	12·70

Thus according to this result the two fibres must be viewed as entirely different, the Chinese white nettle being ever so much superior to the Indian Rhea or Ramia In connection with the Colonial and Indian Exhibition a special effort was made to procure as extensive a series of Rhea and allied Rhea fibres as possible. This failed signally owing to few if any of the samples of fibre, contributed by local officers, having been accompanied with dried botanical specimens of the plants from which they were prepared. It was thus impossible to tell which was which and all were stated to be *Rhea* or *Poi*. The Glen Rock Company, Limited, of Wynaad, exhibited admirable samples of *Rhea*, as also did **Messrs. Reinhold Bros.** of Calcutta, and a French firm showed *Rhea* manufactures, the

NOTE.—* **Mr. Montgomery's** results in this light are highly instructive. He regards China-grass and Rhea as distinct. * (See p. 307.)

fibre having been prepared by the Favier process. These special mercantile exhibits were over and above the very extensive collections made by Government agencies. Samples of all the Rhea fibre in the Exhibition were given to **Messrs. Cross, Bevan and King** for their report, but as they publish but one analysis, it is impossible to discover to which it refers. The presumption is, however, that it was a sample of **B. nivea**, and to contrast with **Muspratt's** result **Messrs. Cross and Bevan's** analysis may be here reproduced.

CHEMISTRY OF THE FORMS OF RHEA.

Moisture	9·0
Ash	2·9
Hydrolysis (*a*) (5 minutes' boiling in Na_2O 1 p.c.)	13·0
(*b*) (1 hour ditto ditto)	24·0
Cellulose	80·3
Mercersing (1 hour in solution of Na_2O of 33 p.c.)	11·0
Nitration	125·0
Acid purification	6·5

Thus in moisture, ash, and cellulose, this agrees very closely with **Muspratt's** analysis. In several of the preceding notes regarding fibres it has been contended that the percentage of cellulose present in a fibre is the best criterion of its industrial value, and accepting **Muspratt's** analysis of Ramia, we are driven to the conclusion that it is a very inferior fibre to the Chinese nettle. A sample of *Poi-rhea* (**Maoutia Puya**) was examined by **Messrs. Cross and Bevan**, which gave only 32·7 per cent. of cellulose, and by the (*b*) Hydrolysis lost 62·7 per cent. of its weight. **Messrs. Cross and Bevan** explain, however, that according to **Mr. King's** microscopic examination, the particular sample of *poi* given them bore evidence of having been badly prepared. They, therefore, in their report, set aside their analysis, and place the *poi* fibre near Rhea as one of the fibres belonging to the first class. The possibility, however, of their analysis being even approximately a correct indication of the relative value of *poi* to **B. nivea**, justifies in the strongest possible terms the line of argument the writer has adopted, namely, to have all the Rhea and allied Rhea fibres thoroughly investigated. The people of Assam prepare a by no means inconsiderable quantity of *poi*, whereas they might just as well grow the Rhea or the China-grass. The injury to a future Indian Rhea trade by a fibre of a distinctly inferior quality finding its way to Europe under the name of Rhea may well be imagined.

(Conf. with p. 314.)

USES OF RHEA.

European Uses and Recognised Properties of Rhea.—"The inherent physical properties of the fibre place it in a pre-eminent position. In strength it is second to no vegetable fibre, and in some trials it has proved to be more than twice as strong as Russian hemp (**Cannabis sativa**). It also presents unusual resistance to the effects of moisture and other climatic conditions, to judge by the slight action of high-pressure steam upon it. Samples of the fibre, exposed for two hours to steam at about two atmospheric pressures, boiled in water for three hours, and again steamed for four hours, lost only 0·89-1·51 per cent.; while flax lost 3·50 per cent.; Manilla hemp, 6·07; New Zealand flax 6·14; hemp 6·18-8·44; and jute 21·39 per cent. At the same time, the fineness of the fibre places it ordinarily before flax, though, according to the method of cultivation, it varies from an extreme degree of attenuation, equalled only by the pine-apple fibre. While in strength, resistance, and fineness it equals or surpasses the best-known fibres, it possesses a silky lustre, shared only by jute, which is by far its inferior in strength and durability. On the other hand, must be mentioned the peculiar hairiness of the fibre, which, while enabling it to combine readily with wool, renders it difficult to spin, on account of its stiffness and brittleness interfering with the twist, and rendering the yarn rough, despite the silky smoothness of the individual filaments

COMMERCIAL USES OF RHEA.

"The combination of qualities exhibited by the fibre endow it with affinities to other fibres, both animal and vegetable, which favour a wide range of application. During the cotton famine, it was tried as a substitute or for mixing purposes, being first cut into lengths of two inches, and treated with alkalies and oil. Fabrics made with equal proportions of the fibre and Egyptian and Indian cotton gained in strength and gloss, and offered no difficulty in spinning and weaving; they also took dyes as well as Egyptian and American cotton, and better than Indian cotton, a little modification of the mordant, and of the strength of the vat, being necessary with a few colours."

* * * * * *

"As a rival to the finest varieties of flax, it has perhaps a better prospect. Technical difficulties, however, arise in spinning the fibre on flax machinery, and owing to the stiffness of the fibre, the yarn produced is often very rough. A number of processes have been devised and patented by **J. H. Dickson** (Godalming), by **Marshall** (Leeds), **Moerman** (Ghent), **Bonsor** (Wakefield), &c., for working up the fibre on flax machinery; but the real conditions of success, where it is attained, are kept jealously secret. In comparing the two fibres, account must be taken, not only of their relative market values, but also of the fact that the commercial *Bœhmeria* fibre still contains much of its natural gum, involving the cost of labour and chemicals for its removal, and consequent loss in weight, before it is ready for combing and spinning. The loss in weight amounts to 23–38 per cent., generally 30–34 per cent., so that the price of the available fibre is increased by 33–50 per cent., without including the cost of treatment. With the finest descriptions of flax, it might compete in price, but the demand for such is limited; that it will ever supplant ordinary flax, appears doubtful.

"The hairy nature and length of the fibre point it out as likely to compete successfully with wool, especially long-shaped kinds, the market values of which are very high in comparison. Several manufacturers, *e.g.*, **Lister, Sangster, Wade & Sons, Whitaker** (Bradford), **China-grass Co.** (Wakefield), have energetically followed up this promising outlet, though not always with success. The fibre is subjected to a chemical treatment, which causes the cells to separate, the longest varying from 4–9 inches. The loss by chemical treatment generally amounts to ⅓ the weight of the imported fibre; combining leaves about equal proportions of long fibre, and tow, or 'noils.' Thus prepared, the fibre has been spun on worsted machinery, and used like mohair, for glossy goods; as a rule, the warp was cotton, and the weft was *Bœhmeria* yarn of comparatively little twist. The success of the experiment was foiled by the ease with which the fabric took and retained creases; this evil has since been remedied by using very thick cotton warps or by mixing with wool. A new effect in woollen goods is now obtained by mixing 10–20 per cent. of *Bœhmeria* fibre with 90–80 per cent. of wool, combining before spinning, say, on the carding-engine or willow, and taking the former a little longer than the latter. The yarn is used for both warp and weft; the wool employed may be either carded or combed; and the cloth can be raised, milled, and woven as usual. In dyeing the fabric, the advantage arises that the two fibres do not take the same dye. Moreover, the noils has been found very suitable for admixture with coarse wools, for blankets, shoddy, and other rough purposes.

"Many experiments have been made in applying the fibre as a substitute for, or in admixture with, silk; but the cost of the fibre, and the difficulties encountered in its preparation, preclude it from competition with jute for this purpose. At the same time, it must be remembered that the study of the industrial applications of this beautiful fibre is yet in its infancy, and the inherent virtues of the fibre must ensure its

extended use in textile fabrics, when the cultivation of the plant, and the extraction and preparation of the fibre, have received higher development. Even now, new uses are cropping up: **Baker, Hill & Sons** (Nottingham) are employing it extensively for ladies' scarves; and the **Yorkshire Fibre Co.** (Wakefield) are converting it into handkerchiefs, umbrella and parasol covers, &c. COMMERCIAL USES OF RHEA.

"The combined strength and lightness of the fibre, and its great durability and resistance to water, favour its application to the manufacture of ropes, cordage, and nets. In all respects, save price, it is much superior to ordinary hemp, and even in the matter of price it does not compare so very unfavourably, as the cost and loss in preparing hemp is very considerable. Its competitors on this ground will probably be Manilla hemp (**Musa textilis**), **Phormium tenax**, and the **Agaves**. For canvas and sailcloth its superiority over flax seems undoubted. To the paper-maker its price is prohibitive; but an admixture of a proportion of noils will impart strength and cohesion to very inferior materials. The average weight sustained by slips of sized paper, each weighing 39 gr., made of this fibre, was 60lb, as against Bank of England note pulp, 47lb, and 'raw' **Agave Americana** fibre, 89lb. Price and uses.

"The market values and supplies of this fibre have hitherto been subject to the greatest fluctuation. The former will depend upon the degrees of success with which the fibre may be made to replace others, as already indicated; and an important condition necessary to the welfare of the industry will be the possibility of obtaining constant supplies, of uniform quality or qualities, and at a figure not exceeding 40*l.* a ton." (*Spons Encycl.*, *931*.)

The attempt made in this paper to establish the fact that there are superior and inferior qualities of fibre regularly sold as Rhea may, therefore, be fitly concluded by the statement that we possess no authentic chemical and microscopic analysis of the Indian-grown **Bœhmeria nivea** and **Bœhmeria tenacissima**.

CULTIVATION OF AND CLIMATE REQUIRED FOR RHEA.—For information regarding these subjects the reader is referred to the account given in the *Dictionary of the Economic Products of India*. Since the publication of that work very little of a practical nature has come to light that calls for any very special modification of the opinions there given. Indeed, the one point of importance has already been indicated, namely, that we have still to discover whether or not the two forms of Rhea have been separately investigated in India; and if not, whether there are areas in India peculiarly suited to the one or to the other. In general terms, it may, however, be stated that past experience would seem to point to the inference that while many species of **Bœhmeria** are indigenous to India and can be freely enough grown,—some being even cultivated for their fibre,—the climate of the greater part of India is apparently not suited to Rhea as a fibre crop. The plant is a perennial, and is not therefore, like Jute or Sunn-hemp, capable of being restricted in its growth to the months of the year suitable to it. The marked transitions from the hot damp rainy season to the dry hot season are unfavourable to the formation of Rhea fibre. During the former, long succulent stems are formed highly suitable for fibre purposes, but during the latter, growth is slow or suspended and the sappy stems of the former are dried up. The final result of this is that long and short joints are formed with numerous knots which oppose great difficulties to mechanical appliances for decortication. On the other hand, such chemical means as **M. Favier's** would probably be workable even with freely jointed stems, since the formation of fibre is continuous and not necessarily interrupted by joints. The experiments hitherto conducted in India, and which have been universally admitted to have been failures, were all directed to- CULTIVATION OF RHEA. Important to India.

CULTIVATION OF RHEA.

wards the discovery of a machine that would cheaply and conveniently decorticate.

In the face of these failures, however, interested parties have continued to prosecute the enquiry; and numerous communications accompanied with admirable samples of fibre are yearly produced. In Assam, where Rhea is fairly extensively cultivated, it has been contended that land for tea purposes is so valuable and labour so expensive that it is highly probable Rhea would not pay as a European industry. On the other hand there are large portions of Eastern Bengal where these objections would have less weight and in which it seems probable some of the forms of Rhea or China-grass might be profitably cultivated. This would also apply to a large part of Madras and along the western coast to the highlands of Bombay. It is being successfully grown in the Wynaad and in Mysore. Perhaps certain parts of Burma, now that vast tracts, particularly in the upper territories, have been thrown open, would be found also highly suitable, though of course the labour question would be serious. It is, however, impossible to hazard an opinion as to a future extended cultivation in India until systematic experiments have been performed with all the better fibre-yielding plants allied to the so-called Chinese grass-cloth.

Notes from Proceedings of the Government of India on the subject of Rhea.

OFFICIAL CORRESPONDENCE REGARDING RHEA.

Having indicated the spirit of some of the numerous communications received by the Government of India, a few extracts from the more important papers may be given. For commercial purposes it is perhaps not necessary to trace the history of Rhea further back than to the time (1869) when that enlightened statesman, the late Lord Mayo, took an active personal interest in the subject. His Excellency was induced to offer a reward of £5,000 for the best machine which would decorticate and clean the fibre from the green stems; and do so cheaply and conveniently. The first exhibition of machines and appliances was held in 1872, and the result having proved a failure, the reward was a second time offered. In 1879 a trial of some ten machines was made, but again, while some of the inventors received rewards, none of the machines were pronounced to have fulfilled the conditions desired by Government. At the same time the opinions briefly indicated above regarding the unsuitability of a great part of India for Rhea, became currently accepted, and accordingly the Governor General in Council felt called upon to withdraw the reward which had been twice unsuccessfully competed for. These trials had, however, a world-wide influence. Inventors in every country turned their attention to the subject, and as the result, numerous contrivances and processes have been patented. The outcome of this awakened interest has been the creation for Rhea of a much more promising position than it ever enjoyed before. The demand for the fibre is steadily increasing, and even India can boast of at least one Company—the Glen Rock Fibre Company of Wynaad—that is devoting its attention largely to Rhea.* Thus in the face of the disappointing features that have been recorded above, India still bids fair to hold its own among the Rhea-producing countries of the world.

Before the Report of the Commissioners appointed by Government to adjudge the merits of the Rhea machines, shown at Saharanpur, had found its way into the hands of commercial authorities, several applications for waste land had been received by the Government of India. The fact that many species of **Bœhmeria** were natives of India, suggested that country as a hopeful field for Rhea and China-grass cultivation. It is needless to publish these letters or the replies given by Government. The fact had to be made known that the information possessed by

* It is reported that a second Company has been established in Bombay—the Bœhmeria Company.

EXPERIMENTAL CULTIVATION OF RHEA.

Government would not justify sanguine hopes of a rapidly successful future for Rhea cultivators. This, it is feared, had the effect of diverting capitalists to other tropical countries. The following official note issued by the Revenue and Agricultural Department gives a complete summary of the opinions arrived at by Government:—

"There appears to be a very general impression prevailing in England, and to some extent in India, that this country is on the whole well suited for the extensive cultivation of the Rhea plant. This is not the case, and as many enquiries have been recently received from various sources asking for information, and in some cases for grants of land and other assistance from Government, it seems desirable that the existing evidence on the subject should be made generally known. The fact is that the greater part of India is unsuited for the profitable cultivation of Rhea as a commercial product, although it may be quite true that the plant will grow anywhere in India.

"Rhea was cultivated for some nine or ten years in and near the Saharanpur Botanical Gardens in connection with the prize offered by Lord Mayo's Government for a successful fibre machine. It was then proved that the Rhea stalk of Saharanpur was usually quite unfit for conversion into fibre. The cause was alleged by a Dutch planter of great experience from Java to be that the stalk was of uneven quality owing to the alternations of dry and wet heat during the season of its growth. Between one pair of joints the stalk was shown to be short, hard and dry, and between another pair to be long, soft, and pliant. If the top of the stalk was ripe, the foot of it was green; if the end was green, the base was only half-grown, and so on, whereas, for purposes of fibre, the whole stalk should be a green flexible wand of even quality throughout, such as can only be produced in an equable climate like that of Java, where the temperature varies but little throughout the year, and the atmosphere never becomes desiccated: a gentle shower or two usually falling every day. It is true that occasionally a spell of rainy moist weather lasts sufficiently long even at Saharanpur to produce one serviceable crop in the year, but Rhea can never be grown profitably unless three or four cuttings can be made in the twelve months.

Opinion of Government of India as to prospects of.

"Now Saharanpur may be taken as typical of the whole of the North of India. Some localities may be a little more favourable, but the majority are less so. In Bengal rain is more abundant in the monsoon (June to September) than in the country of which Saharanpur is typical, while there are, in many parts of it, Calcutta for instance, earlier rains in April and May. But the following is the testimony of Dr. King, Superintendent of the Botanical Gardens at Calcutta, who tried practical experiments with Rhea on the banks of the Hooghly:—

"'The experience I have already had of the growth of Rhea in Bengal, supplemented as it has recently been by the opportunity afforded me of visiting Java and the Malay Archipelago, makes me doubt very much whether Rhea can ever be grown to commercial advantage in Bengal. The soil in this Province is poorer than that of Java and the islands of the Malay Archipelago, and manure is obtainable with difficulty even near large stations, while in the mofussil it is almost an impossibility. Rhea will certainly not yield well in Bengal without plenty of irrigation during the hot weather and copious manuring once a year. It is, moreover, a plant which naturally grows in an equatorial climate. The low temperature (and especially the low soil temperature) of the cold weather and the dry heat of the hot season in Northern India are equally ill-suited for it. I believe that even if Burma had every other condition in perfection, the high price of labour in that Province would be fatal to financial success.'

"The following extract from a note,* called for by the Government of India in 1881, gives a clear summary of the results gained up to that date, and is generally confirmed by later experience:—

"'The idea of opening a public competition for a machine to clean Rhea fibre I think grew up very naturally from the correspondence regarding the cultivation of the

* By Mr. Baden-Powell, C.S.

OFFICIAL CORRESPONDENCE REGARDING RHEA.

plant in India. No one reading that correspondence could avoid the conclusion "that the fibre can be grown; the *crux* is, how to prepare it as a marketable commodity when it is grown." The two questions unfortunately "see-saw" one upon the other; it is no use growing the fibre if we cannot prepare it for market; it is of no use to invent machines if the fibre cannot be grown in suitable quantities.

"'Among plants which are recommended for acclimatisation, we find three classes: (1) plants that seem to take to almost any climate; (2) plants that will only grow under certain specific conditions like *Ceara* rubber, *Pithecolobium*, &c.; (3) plants that *will grow*, but under what I may briefly call, "garden cultivation." It is the last class that cause expenditure, raise great hopes, give rise to flaming reports of success, and great deal of correspondence, from which it is very likely that a false conclusion will be drawn, false in fact, though seemingly quite in accordance with the evidence. To this class I am afraid Rhea belongs. There is no doubt that you can grow it with care in Lucknow, Bareilly, Saharanpur, Dehra Dun, and even in Lahore, as well as in Calcutta, the Sunderbans, Assam, and other places. But to grow a thing in such a way as to produce a fine garden of ten acres and evoke an "interesting" report is one thing; to grow it commercially is another.

"'I think if we look back to the collected evidence, there was much reason to conclude that Rhea would grow, but not that it would grow commercially. It is an *equatorial** plant, and this clearly points to its requirements being a great *equability* of conditions. Dry heat burns it up; drought kills it outright; frost it will not stand (though frost is one of the conditions that is more easily overcome after some time of establishment). Even *cold soil*, such as Calcutta has during the winter, is unfavourable.

"'What Rhea wants is a moist air, no long dry hot months, a naturally rich soil, which does not need much manure, plenty of rain, and no extremes of temperature. The manure difficulty is not of such importance, except in places where it is difficult to procure or costly. It does not need much horticultural science to perceive that a plant may be coaxed into living where these conditions are not general. A sheltered garden may produce the plant when the fields all round would not. Poverty of soil may be overcome by manure. Artificial irrigation may obviate natural effects of a dry climate. The more care is given, the more these helps remove defects of climate and the better the plant. Their cost, and the difficulty of applying them on a large scale, is not appreciated when the area of trial is small, and if the experimenter is an enthusiast, his report is full of confidence. Even when very good results are not obtained, still partial results are.

Note.—It is grown in Eastern Bengal as a field crop, see p. 285, and in Kangra, see p. 307, 311.

"'I believe then that the just conclusion regarding Rhea is this: it is no use trusting to results obtained under special conditions. Even the Howrah experiments are of no use as a test, except to show that Rhea will not grow in a commercial sense in Calcutta. Saharanpur and all the other trials have been "garden cultivation," and even so have not been successful. Unless Rhea can be grown in some districts as an open field crop, with just so much care as an ordinary well-farmed field for a rather superior crop gets, there is no hope for it. In China even it is evident from Dr. Watson's report that manure is largely given. In India this is always a drawback, but not an insuperable one on a large estate.

"'The only chance is to look out for places where the natural conditions are as like those of Sumatra, Java, &c., as possible: where there are no extremes, where the soil temperature is not low in winter, and where there is plenty of moisture. Burma is probably out of the question, because of the labour difficulty. The only districts that do not seem to me hopeless are Upper Assam, Dacca, Dinajpur, &c. No flooded land is of the least use—floods kill the plant.

"'Now as regards Assam, there is a report from the Conservator of Forests, which says that even there the fields require digging carefully, fencing and plenty of manure; and that "if its extensive introduction into the home markets depends on its being supplied at an average price of £30 to £40 per ton of rough fibre, * * this province will not be a source of supply, since it cannot be produced at double that rate at present."

(Conf. with p. 311.)

"The conclusion drawn in the final paragraph of the above extract is probably correct, though it may be the case that some parts of Southern Madras should be added to the list of likely localities. There is reason, too, to believe that certain tracts in Burma (probably the lower hills of Pegu and Tenasserim) would be found suitable, and as the labour difficulty is decreasing under a system of free emigration, the time may come when that province may afford facilities for Rhea cultivation.

* See the contention (pages 284 to 287 and 305) that there is both a temperate tropical form.—*Ed.*

EXPERIMENTS WITH RHEA.

"At present, however, India cannot be looked upon as a favourable field for the Rhea industry."

A reference was made to the Assam Government on the subject of allotting waste land in that province to intending Rhea cultivators, and the following extract from an official letter expresses clearly the prospects that might be expected from such a venture:—

"The Rhea plant is commonly grown in Upper Assam by Doms and other fishermen who weave their nets out of the fibre. It is cultivated in small patches close under their houses, rudely fenced in and manured liberally with cowdung. Under this treatment, which involves no manipulation of the soil, nor any trouble in cultivation, the plant thrives luxuriantly, and supplies a sufficiency of fibre for all their wants. It is much to be doubted, however, whether, looking to the cost of living and of labour in Assam, a European could make Rhea cultivation on a large scale pay. Three years ago, the Director of Agriculture in Assam collected some statistics about Rhea fibre in view of the large prices offered for it in England by manufacturers who combine it with silk and other materials for hangings and similar fabrics. The English prices appeared at first sight to promise a large profit, but on working the calculation out with reference to the actual price of Rhea fibre in its coarsest shape on the spot, it appeared that there would be scarcely any margin left even to pay the cost of carriage."

Cultivation in Assam. (Conf. with p. 299.) (Conf. with pp. 300, 306 & 312.)

A very different opinion regarding Assam will be found at page 312.

Cultivation in Madras.

That Rhea can and is being successfully cultivated in India, may be judged of from the following communication received from the Manager of the Glen Rock Company, Limited, Wynaad:—

"**Mr. W. Gollam**, Superintendent of the Botanical Gardens at Saharanpur, has kindly given me some information as to his past experience in the cultivation of Rhea, but tells me that the cultivation of Rhea has been discontinued since 1880, and that he cannot now recall many facts with which he was then familiar. He advises me to write to you and beg for copies of all the official reports on Rhea, and thinks if you have spare copies you may be able to help me.

"This Company has now 250 acres of land planted with Rhea in 1885, and a further 250 acres will be planted this year. I am most anxious to get information as to past experience in this cultivation. What I have hitherto learnt of the past is from experience obtained on very small areas of land and under exceptional circumstances.

Yield: see pp. 287, 297, 300, 305, 309, & 312.

"I want to know what has been the actual weight of green stems per acre for cutting from any considerable extent, and what the percentage of clean fibre or Filasse obtained from the green stems by any mode of treatment.

"I have the pleasure to send you a sample of the Filasse as treated here. The result and cost of the treatment is considered satisfactory, but the percentage of Filasse to the green stems cut is disappointing in comparison with statements given as to results elsewhere obtained, and the weight of green stems per cutting per acre, which varies here considerably according to the lay and circumstances of the ground, is generally less than was anticipated.

"The information given me by **Mr. Gollam** of his recollection of average results agrees much more nearly with my experience here than the figures given in French and other books published on the subject, or with the estimates in **Dr. Forbes Watson's** Report of 1875."

The question asked by the Company as to yield of fibre cannot, it is feared, be satisfactorily answered in India. All the reports and publications in the possession of Government deal only with experimental cultivation on a very small scale. In the *Dictionary of the Economic Products*, page 470, the various opinions hitherto published have been

OFFICIAL CORRESPONDENCE REGARDING RHEA.

briefly reviewed with this one only certain conclusiont, hat so far as India is concerned, the results do not confirm those published by continental authorities. Either these are overstated, or the plant in India is by no means so productive of fibre as in Europe and China.

The following extracts from the Proceedings of the Government of India give the main facts which have been learned up to date :—

Report by the Officiating Inspector General of Prisons, Oudh, on the Cultivation of Rhea (Bœhmeria nivea) *in the Jails of Oudh.*

In paragraphs 4 and 5 of letter No. 57, the Secretary of State for India calls for information on the following points :—

(A) The measures which seem best adapted for the purpose of conducting experiments on Rhea fibre.

(B) The cultivation of the Rhea plant, precise information being required on—

(1) The variations in quantity and quality due to difference in—

(*a*) Season. (*d*) Soil.
(*b*) Growth. (*e*) System of cultivation.
(*c*) Age. (*f*) &c., &c.

(2) The most economical system of cultivation generally.

2. The Rhea plant has been cultivated to a small extent in nearly all the Oudh Jails for some years past,—in one or two for a period of eight or nine years; and with the view of obtaining such information as might be procurable from the officers in charge of jails, a series of questions was submitted to them by Dr. Sutherland, to which categorical replies were required.

These questions embraced the following points bearing on the cultivation of the plant, the outturn, and the methods actually employed in the jails to separate the fibre :—

I.—(*a*) The soil, and (*b*) the manure best suited to the plant, and (*c*) the number of years during which the plants will produce freely.
II.—The amount of irrigation required in hot weather.
III.—The effect of frost, whether destructive or not.
IV.—The best interval to be left between the plants to ensure straight growth.
V.—(*a*) The number of crops 4 feet high to be obtained each year after abundant irrigation and manuring.
(*b*) The seasons for cutting the crops.
(*c*) The yield per acre.
VI.—(*a*) The time, and (*b*) the method of separating the bark from the fibre, and the fibre from the wood (1) in the fresh green, and (2) in the dried state.
VII.—The (*a*) object and (*b*) duration of the retting process if employed; whether it is used with (*c*) green or (*d*) dried stems; (*e*) whether it can be carried out in the rains, and (*f*) whether chemicals are required.
VIII.—Method of removing gum if not steeped.
IX.—Specimens and description of fibre as it can be best produced, and the rate at which it can be offered per maund at the jail.

3. These questions by no means embrace the whole points on which information is sought, as they leave out of sight those embodied in it as being beyond the experience of Superintendents of Jails, and do not touch at all on many of the most important in connection with relations of quality and quantity to season, soil, age of plant, &c.

Exact information could scarcely be looked for from jail establishments, as the cultivation has in no case been in any way extensive, the

largest area placed under Rhea cultivation in any one jail probably not exceeding 1½ to 2 acres, and no experiments have been systematically made on the influence of soil, amount of irrigation, &c., on the quality and quantity of the outturn of fibre. EXPERIMENTAL CULTIVATION OF RHEA.

4. The conclusion to be derived from the reports submitted is that attention has not been directed to those points, the plants having been planted and cared for in a way, no very great attention having been paid to the cultivation, at any rate in most instances, as the fibre, when extricated, with the rude methods at command, would never be remunerative even when the day's wage of a prisoner was placed at so miserable a sum as 6 pie.

5. The information obtained from the Superintendents of the different jails, such as it is, is embodied in the following paragraphs.

Replies to the circular have been obtained from all the Jail Superintendents, the last being received on 11th March 1876.

6. (*a*) *Season.* The information on this point is virtually *nil*, as regards its relation to quantity and quality, Dr. McReddie only mentioning that the autumn produce after the cessation of the rains is the most abundant, the stems then growing to a much greater height.

The number of crops that can be obtained in a year with free irrigation and manuring is three after the rains, in early spring and in June; but on this point there is no agreement between the various reporters.

Three crops are obtained.

In Partabgarh . .	February, June, and October.
„ Fyzabad . . .	March, June, and October.

Crops. (Conf. with p. 301.)

Two crops.

In Lucknow . . .	June and October.
„ Hardoi . . .	February and September.
„ Gonda . . .	April and October.

One crop.

In Bahraich . . .	November.
„ Sultanpore . . .	September.

In the other two jails and even in the two last it is cut irregularly and when required.

The only information submitted on the total outturn relates to the whole year's produce, and is mentioned in but three reports.

The yield per acre per annum in these is given below :—

	Green stem.	Rough uncarded fibre.
Lucknow . . .	160 maunds	8 maunds.
Partabgarh . . .	...	1 maund.
Hardoi . . .	10 maunds	...

The difference in these estimates is certainly remarkable, and I am inclined to place no reliance at all on those of Partabgarh or Hardoi. In the absence of reliable information as to soil, manuring, &c., it is impossible to guess even at the cause of this discrepancy.

7. (*b*) The relation of quantity and quality to the period of growth must remain unanswered. Dr. McReddie states that the fibre is much finer and more delicate when obtained from the young stem.

8. (*c*) As regards age, the only information given is that the first plants, planted some eight or nine years ago, still produce freely; but there is no evidence as to whether the older plants are deteriorating or not.

9. (*d*) Nothing absolute can be learnt as to the nature of the soil most suited to the successful cultivation of the Rhea, as it appears to thrive in all kinds so long as water and manures are freely supplied, whether it be clay as at Lucknow, or sand, with only a small portion of clay, as at

OFFICIAL CORRESPONDENCE REGARDING RHEA.

Partabgarh, or light and sandy as at Hardoi, or *domattí* (sand and clay mixed) as at Fyzabad.

10. (*e*) System of cultivation.

All are agreed that free manuring is necessary, but not as to the nature of the manure, some preferring vegetable and some animal.

At Lucknow the ground was at first starting very freely manured with the ordinary jail manure, but has subsequently had nothing more than that obtained from the leaves of the plants themselves, which are stripped and left on the spot after the plant has been cut. Certainly, the plants thrive on this, and it is by far the most economical plan.

The plants require to be placed on raised ridges, for though requiring and using a considerable amount of water, they are liable to be injured if water is allowed to lodge at the roots. With reference to the amount of irrigation required opinions differ. In Fyzabad I gather that it is carried on all the year round except during the rains, and this I believe to be necessary. The question, however, was only put on this point as to the requirement during the hot weather, and on this opinions differ in a very marked degree, from two or three times in the month as at Sitapur, Lucknow, and Hardoi, to twice or even three times a week, as at Unao, Partabgarh, Gonda, and Fyzabad. This is a matter of considerable importance in connection with the economical cultivation of the Rhea, and I am induced to think the Lucknow estimate the correct one.

(Conf. with table, pp. 302, & 304.)

11. Another point for consideration is the best distance apart at which to place the plants. In the Saharanpur garden two feet is the distance found necessary to ensure free and straight growth without wasting space, and this is the standard most generally accepted by Jail Superintendents, though one or more consider three or four feet as necessary. There is nothing to show, however, what influence the greater or less distance has on the outturn either in fineness of fibre or amount.

12. No remarks are made on the influence of shade on the growth, though it is my impression that this is supposed to proceed more satisfactorily when there is a fair amount of shade.

13. The remainder of the enquiries were addressed to the processes in use to obtain the fibre from the stem, the use of chemicals in retting, and the price at which it can be produced.

The method employed for separating the fibres is so primitive, and the instruments so rough, and the process so slow, that it is scarcely needful to enter into consideration of them, especially as the whole question has arisen out of the desire to find some machine that will perform the first process rapidly and economically so as to make the production pay. This hand labour never can do, and hand labour alone is available. **Dr. McReddie** estimates that cleaned fibre will cost R7-8 per maund at the jail. One prisoner cannot, he considers, prepare more than 4 chittacks a day, calculating from the number employed during the whole process from first to last and the amount of outturn; this, at 6 pie per diem per man as wage, would give R5 per maund. To this must be added R2-8 cost of cultivation, making in all R7-8 per maund at the jail or £28 per ton. **Dr. Forbes Watson** gives the price to be paid in London at £30 to £40 per ton for the better, and £20 to £25 per ton for the lower qualities, so that the above rate for the uncombed fibre would leave no margin for profit after freight, &c., has been paid, supposing even £30 per ton were obtained in London.

Price £28 a ton.

(Conf. with pp. 288, 300, 308.)

The total outturn also would be very small, as **Dr. McReddie** considers that half a ton per annum would be fully as much as he could produce. Other estimates of the cost per maund have been given, but being little more than mere guesses, need not be quoted.

Other questions raised with reference to the preparation of the Rhea fibre is the need of retting for the removal of gum and the use of chemicals.

EXPERIMENTAL CULTIVATION OF RHEA.

The fullest description of the process comes from the Lucknow jail. Dr. McReddie, who seems to have paid attention to the subject, expresses his opinion that the process should commence immediately after the stems are cut, as any delay increases the amount of gum found in the fibrous layer and the difficulty of separation and clearing the fibre. He considers that it should not be left one night even. If this precaution is attended to, the amount of gum in the fibre is small and easily removed during the subsequent retting process.

The first step is to clean off the outer epidermal layer by scraping with sharp-edged pieces of bamboo and by rubbing with gunny, and then to remove the fibre in strips with the fingers. This process is never undertaken in the dry state.

The next state is that of retting, by which fibres are separated, and any remaining gum removed.

A solution of impure carbonate of soda (*sajji*) is prepared, two ounces being added to a gallon of water and boiled down till two-thirds remain. The clear portion after standing is decanted off, and about five seers of the raw fibre are placed in it, sufficient water being added to cover the fibre completely.

It is allowed to remain thus from 7 to 20 days according to season, and the fibre is then removed from the water, well washed, and dried. The washing is continued until the fibre is perfectly clean and bleached.

For spinning, the fine fibre is prepared from this by combing or by hand-picking.

In some jails the stem is allowed to partially or wholly dry, and then retted, *sajji* or alum being used to assist in the removal of impurities.

15. In conclusion I must express my regret at the absence of clear and definite information on the points in question, which arises wholly from the fact, I presume, that the attention of those superintending the cultivation of Rhea has not been directed to them, at any rate, in a constant and prominent manner. Jail Superintendents as such are naturally liable to treat any employment of prisoners that is not remunerative with callousness. Should a further series of experiments be considered advisable in jails, I would suggest that they should be confined to three or four jails, and be carried out in them on a more extended scale and in a systematic manner.

16. The delay in the submission of this report has arisen from that of he receipt of some of the reports.

Report by GUSTAV MANN, Esq., *Deputy Conservator of Forests, Assam, on the Cultivation of the Rhea plant in Assam.*

Cultivation in Assam. (Conf. with p. 295.)

The Rhea plant (*Bœhmeria nivea*) is cultivated everywhere in the Brahmaputra valley districts, but grows much better in Upper than in Lower Assam on account of the greater moisture and heavier rain. No more congenial climate than Assam exists, probably in India, for the cultivation of this plant, for it grows to the greatest perfection possible where it receives the requisite care and cultivation.

2. It is at present only grown by the fishermen in this province, on account of the superiority of its fibre for the manufacture of nets and not for sale, since, even at the present high price, varying from R1 to R2 per seer, nobody would consider the cultivation of Rhea worth the trouble, as it only grows well where it receives a very great deal of attention in the way of loosening of the surface soil, plenty of manure, and careful fencing.

3. Soil open and friable, slightly loamy, and not too sandy, is best suited for its growth. The locality where it is planted must be high, so that there is no risk of inundations, since, even if the water remained only a short time on the land, the plants would be ruined.

4. The cultivation has been described by Major Hannay and others correctly, so that there is nothing for me to add on this subject. The (Conf. with pp. 285 and 317.)

OFFICIAL CORRESPONDENCE REGARDING RHEA.

(Conf. with pp. 295 and 305.)

plant is propagated by parting the roots, and improves in the same degree as the soil is worked or loosened, kept clear of weeds, and manured. It is cut from three to five times annually, and reaches a height of from 4 to 5 feet.

5. The outturn per acre, according to the statements of the dooms, or fishermen, in the different districts where I made inquiries, is only from 200 to 300lb of clean fibre an acre per annum; but their statements are very unreliable.

6. The main question at issue is, whether the Rhea plant can be cultivated sufficiently cheaply in this province so as to allow the fibre to be used to a greater extent in the manufacture of cheap articles, produced in large quantity, so that it may become a great staple and develop into a large trade, as is pointed out by Dr. Watson, in paragraph 45 of this report. If its extensive introduction into the home markets depends on its being supplied at an average price of £30 to £40 per ton of rough fibre, as stated by Dr. Watson in paragraph 46 of his report, this province will not be a source of supply, since it cannot be produced here at even double that rate at present, or in future either as far as can be judged now, for its production requires as much time and labour as tea does, whilst the latter plant produces on an average 280lb per acre, and fetches on an average one shilling and eight pence per pound in Calcutta.

Price. (Conf. with pp. 288, 298, 306.)

7. In fact, at the above low value of Rhea fibre, as quoted by Dr. Watson, it would only give a return about equal to rice, whilst its cultivation requires double and treble the time and attention. For this reason, I do not even see a likelihood of its being grown in the Sylhet district, where there is a greater population, and labour is comparatively cheap.

(Conf. with pp. 295 and 312.)

8. From the above remarks it will be seen that Rhea fibre has no chance in this province, since the success of tea cultivation will, as far as can be judged at present, always prevent European capital being employed on Rhea cultivation, and it is far too laborious for natives of this province to take to, as they have done in Bengal to jute cultivation, for the sake of gain, as long as the fibre has to be produced at £40 per ton.

Report by J. F. DUTHIE, Esq., *Superintendent, Botanical Gardens, Saharunpur, on the Cultivation of Rhea from June 1877 to November 1878.*

Cultivation in North-Western Provinces.

A short account of the history of Rhea cultivation at Saharanpur, from its commencement in 1870 up to June 1877, has already been given by the Director of Agriculture and Commerce, North-Western Provinces and Oudh, in a note, No. 155 T. A., dated 27th June 1877.

The present report will, therefore, relate to the operations which have taken place since then, including certain experiments which I have undertaken in accordance with some suggestions of Dr. Forbes Watson's in his report published in 1875.

The total nominal area in June 1877 was 32 acres, but a good deal of this land had got into very bad order, owing partly to irregular demand in previous years for supplies of stems, and mainly by reason of insufficient funds to keep up a large area in a high state of cultivation.

In a letter, No. 690 L. A., dated 13th May 1878, instructions were received from the Director of Agriculture and Commerce, North-Western Provinces and Oudh, to get ready 20 acres of land for the supply of Rhea stems in the autumn of 1879, to the competitors for the prize of ₹50,000 offered by the Government of India for the best fibre-cleaning machine.

For this purpose it was considered advisable, in order to secure a good uniform crop, to plough up those portions of land which had got out of condition, and to replant afresh during the succeeding rains.

It was proposed, in the meantime, to make use of the ground by raising a crop, the profits from which it was hoped would help to defray the

EXPERIMENTAL CULTIVATION OF RHEA.

cost of removing and replanting the Rhea. In December last, the ground was accordingly sown with various kinds of melons, the fruit of which was sold by auction. Very unseasonable weather, however, occurred just at the time when the fruit was ripening, and the geater portion of the melon crops in this district were destroyed, so that the sum realized fell far short of what was expected.

After this (27th May) the land was again well ploughed and prepared for Rhea, and the roots were put in during the following rains.

Planting.—The method of planting was as follows: The land after being well ploughed and thoroughly cleaned was divided into the usual longitudinal beds for irrigation purposes. Holes were dug 2½ feet apart, and these were filled in with manure composed of a mixture of horse-dung or of city manure, and the ashes of burnt Rhea leaves in the proportion of about 7½lb of the former and 1½lb of the latter, and the whole thoroughly mixed with a small quantity of the ordinary soil of the ground. Into this some healthy roots were planted, 6 to 10, according to their size. The beds were then kept constantly irrigated and carefully weeded, until the plants became high enough to prevent any further growth of weeds.

Cutting.—At Saharanpur it has been the practice to take only two crops during the year, one in June and the other in October or November. By this arrangement the stems are allowed to grow to their maximum degree of ripeness, any further delay causing injury, at the former period by the growth of lateral branches, and at the latter by the production of flowers.

Two Crops. (Conf. with pp. 297 and 308.)

It is more than probable, however, that a much finer quality of fibre can be obtained from crops cut more freqently than twice during the year, and this I hope to be able to show from the results of experiments undertaken to ascertain this point.

The first crop of this year was cut towards the end of June. From the newly-planted portion of ground, no stems were ready to be cut at this time.

The second crop was cut during the latter half of October; this included about an acre and a half of the newly-planted ground. A few more cuttings can still be made from the more recently planted portions.

Great care has been taken in the preparation of the newly-planted ground, especially with regard to a uniform system of manuring and planting, so as to secure a good even crop at the time required.

Experiments have been undertaken during the present year with the object of ascertaining the effects on the quality of the fibre of different methods of cultivation.

These relate chiefly to—

(1) Monthly cuttings.
(2) Spacing of plants.
(3) Manuring.

Samples of fibre have also been prepared from stems from certain pieces of ground where the conditions of soil and former treatment were sufficiently marked to lead me to expect a corresponding variation in the condition of the fibre.

For the preparation of the various samples of fibre, I am entirely indebted to a gentleman at Agra, who has been good enough also to give me his opinion on the quality of each.

The fibre was extracted in the majority of cases from dried stems, and all appear to have received the same treatment in the process.

A specimen of each sample of fibre shall be forwarded with this report.

The experiments in connection with the application of different kinds of manure are not yet completed. A report on the results shall be submitted as soon as possible.

Statement shewing some results of experiments on fourteen samples of stems.

Number on samples.	Date of cutting.	WEIGHT. GREEN. Stems.		Leaves.		Dry stems.		Average length of stems when cut.	Fibre extracted.	Conditions of soil and cultivation.
		lb	oz.	lb	oz.	lb	oz.	in.		
9	March 1878	...	...	...	...	...	...	25	28th October 1878	These are monthly cuttings taken from about one-tenth acre forming part of a small rich piece of ground somewhat shaded by trees. The plants have remained undisturbed here for upwards of seven or eight years, so that the roots have taken complete possession of the ground to the exclusion of weeds. The best crops are produced here, and the stems are usually free of knots and of uniform thickness.
1	June 1878	98	...	146	...	22	...	19	Ditto	
2	July 1878	54	...	106	...	17	...	20	Ditto	
3	August 1878	80	...	124	...	12	...	17	Ditto	
4	September 1878	114	...	192	..	14	...	21	Ditto	
8	October 1878	60	...	116	...	10	...	18	Ditto	
15	November 1878	18	...	32	...	2	8	0		
12	16th November 1878	...	...	...	...	...	...	13	23rd November 1878	From stems of 14 days' growth.
5	14th October 1878	...	...	...	...	1	1	10·24	28th October 1878	Stems from plants put in 1 foot apart. Planted about the end of February 1878.
6	Ditto	...	...	...	...	2	...	14·26	Ditto	Ditto 2 feet apart.
7	Ditto	...	...	...	...	2	9	15·36	Ditto	Ditto 3 feet apart.
11	June 1877	...	...	...	...	...	...	33	Ditto	From dried stems taken at random from 1st crop of last year.
10	November 1877	...	...	...	...	...	...	37	Ditto	Ditto 2nd crop ditto.
13	16th November 1878	...	...	...	...	...	...	23	21st November 1878	Stems half ripe. From a piece of ground re-planted in March 1878. The roots were put in 6 inches apart.
14	Ditto	...	...	...	...	...	...	29	Ditto	Stems fully ripe.

N.B.—The fibre of Nos. 12, 13, and 14 was worked up from green stems; all the other samples were prepared from dried stems.

J. F. DUTHIE,

Superintendent, Botanical Gardens, Saharanpur.

OFFICIAL CORRESPONDENCE REGARDING RHEA.

A short account by J. F. DUTHIE, Esq., *Superintendent, Botanical Gardens, Saharanpur, of each sample of fibre extracted from the stems enumerated in the preceding Statement.*

No. 1.—The stems are smooth and free from knots. The boon is brittle and easily broken. The harl is dry, tough, and tenacious, and does not break much when breaking out the boon. The outer bark separates freely from the fibre and the fibre is fine and soft, and of a uniform colour of whity-brown. It is slightly glossy.

No. 2.—These stems are about the same length and thickness as No. 1. A sort of dry rot appears to have set in among them, and the boon crumbles on the breaking of it. The harl is not so tenacious as that of No. 1, and breaks very readily in passing through the machine. This causes an excess of boon waste. The fibre is not so fine or soft as No. 1, or even so tenacious. The colour is a sort of dirty whity-brown. The crumbling of the boon renders its separation from the harl an easy task, but the agent that works the boon into this crumbling state works also on the harl and takes away its toughness, renders it more brittle, and easily broken. As a consequence, the fibre produced is shorter and there is more waste.

No. 3.—These stems are not quite so thick as Nos. 1 and 2. They have something of the appearance of stem No. 1. The boon is brittle and breaks readily. It separates freely from the harl. The harl is not so brittle as No. 2, but resembles it a great deal. The fibre appears wanting in tenacity; it is stiff and rough to the touch. It is much the same colour as No. 2.

No. 4.—These are nice clean-looking stems, and such as take the eye; they are not quite so thick as No. 1, but more uniform. They are lighter in colour than Nos. 1, 2, and 3. The boon is more solid than that of either Nos. 1, 2, and 3, and yet just as brittle, if not more so. It separates easily from the harl. The harl is tougher than either Nos. 1, 2 or 3, and is more tenacious and not so ready to break. There is not much boon waste. The adhesion between the bark and fibre is rather stronger, but separate readily notwithstanding. The fibre obtained is fine and soft, and almost full length. It has a nice soft feel and a glossy appearance, but has a slightly greenish tinge.

Nos. 5, 6, and 7.—These stems are hard and knotty, and not easy to work, are very irregular in thickness, and are of a very dark colour and thick-skinned. The fibre obtained from them is rough and hard, and they produce a good deal of waste on account of their hardness and being full of knots. The harl breaks off at every knot.

No. 8.—These stems are much more slender than any of the previous numbers, are clean and smooth. A little darker in colour than No. 4, but not so dark as Nos. 1, 2, and 3. The boon is brittle and breaks easily, and is easily separated from the harl. The harl is very tender and breaks with much less force than any of the other monthly cuttings. It requires to be very carefully operated upon until the bark is freed from it and it gets a working up. This working up increases the tenacity of the fibre considerably. The fibre is very fine and soft, has not that stiff rough feel which characterises some of the other samples. Its colour is greenish, more so than No. 4, which may be owing to the freshness of the stems.

No. 9.—These stems are regular in thickness, have a nice clean appearance, are smooth and of a light colour, much lighter than No. 4. The skin or bark is not so thick as on any of the other stems, but in this particular Nos. 1 and 8 approach very near. They are very easy stems to work up. The boon is brittle and the harl tough; it comes from the machine without being much broken, and with scarcely any waste. The bark separates very easily from the fibre. The fibre is very smooth and

EXPERIMENTS WITH RHEA IN INDIA.

soft, and has not that stiff rough feel referred to as possessed by the other specimen. It is of a lighter colour.

No. 10.—These stems do not appear to be so uniform in thickness as No. 11. They work up better than No. 11. The boon is solid and brittle, and the harl is more tenacious than No. 11. The bark separates readily from the fibre. The fibre is hard and rough, and appears to be stained by the juice of the stem in irregular drying.

No. 11.—The stems are fairly regular, but inclined to be knotty. The boon crumbles in the breaking, and the same agent appears to have been at work here as described in No. 2. The harl is also affected. It is brittle and breaks across very readily, and more waste is produced. It is not difficult to remove the bark. The fibre is much shorter in comparison with the length of the stems than any of the samples, and is hard and rough. It is also of a darker colour. The stems are attacked by some kind of insect which bores a small round hole into the boon, causing a break in the fibres. The whole of the fibres which are cut by this insect tears off into waste in breaking up the stems and working the fibre out.

No. 12.—These stems are very thin and are awkward to work up through being so short. The bark separates freely from the fibre, but the adhesion between the woody portion and the harl is rather strong. The fibre produced is soft and fine, and of a light colour, and separates readily into finer filaments.

No. 13.—The woody portion of these stems was very soft and tough, the core of the woody portion quite green and full of juice. The harl separates from the woody portion better than in No. 12. The bark separates very readily indeed from the fibre. The fibre obtained is soft and fine, but not so fine as No. 12. It is of a light colour, slightly greenish.

No. 14.—The woody portion of these stems is hard, but not very brittle, yet not so tough as No. 13, and the core is more or less dry. There is more dryness between the harl and boon, and more adhesions of the one to the other, the juice having dried to a great extent and fixed the fibre to the boon or woody portion, which is still in a fresh juicy state. The bark does not separate readily from the fibre. The fibre is not so soft as either No. 12 or 13; it is more stiff, hard, and brittle; it is just as fine as No. 13.

I will now state briefly some conclusions which may be drawn from the above experiments. It is clear from the habit of growth of the Rhea plant that whatever distance apart the roots or plants are originally put in, they will, unless purposely prevented, gradually approach each other and fill up the interspaces. I have observed that in proportion as these conditions are allowed to act the better and more uniform does the crop become, and, what is of more importance, the quality of the fibre is also improved.

(Conf. with pp. 298, 307.)

It is again evident from observation that the greater the spaces are between the plants the more room there is for the growth of weeds, which spring up with great rapidity in a soil which has to be so liberally supplied with water and manure. In those pieces of ground where the plants have had time to spread over the whole ground, few weeds can exist. Another advantage in a compact crop, and especially in a dry climate, is the shade afforded by the leaves over the entire ground. During the hot weather a certain number of leaves are continually falling, and these also contribute to moisten and manure the ground—conditions which are particularly favourable to a shade-loving plant like the Rhea.

I believe, therefore, that in planting out Rhea, good crops will be more quickly obtained and with greater economy by putting in the roots or plants as close as possible in lines, as far apart only as is necessary for

weeding and hoeing purposes, until the plants have strength enough to maintain their own ground.

OFFICIAL CORRESPONDENCE REGARDING RHEA.

From J. G. CORDERY, Esq., Deputy Commissioner, Kangra, to the Commissioner and Superintendent, Jullundur Division,—No. 106—228, dated 15th March 1876.

Kangra in the Punjab.

With regard to your No. 2314, dated 25th October last, in forwarding to you a copy of the report which has been furnished to me by Mr. Montgomery, the conductor of the experiments which have been made in the cultivation of Rhea-grass in this valley, I confine my own remarks to the points on which the results coincide with, or differ from, those shown in Dr. Forbes Watson's printed report.

(*Conf.* with p. 286.)

2. It will be noted at once that the plant with which Mr. Montgomery has been concerned, and which alone has been grown in this valley, is the China variety of the species, and not that indigenous to India. This fact will perhaps serve to explain the variation in the results as compared with those detailed in other reports.

3. On the question of the propagation, actual cultivation, and reaping of the plant, which is treated at some length by Mr. Montgomery, and in detail, which is rendered of much value by an experience of twelve years, the printed report does not touch, and the paragraphs in which these subjects are dwelt upon may probably be held to have added a good deal to our information as to the best method of introducing the Chinese variety into this country.

(*Conf.* with pp. 295, 300, 309.)

4. With regard to the very important point of the outturn per acre, it will be seen that longer experience has induced Mr. Montgomery to enhance his former estimates. If an acre, as he argues, can hold 3,000 plants, each of which is allowed to grow to a height of six feet, and each of which yields six stems, and if out of every 1,000 plants the average yield of clean fibre is 18lb, the total result is, as he expresses it, $\frac{3{,}000 \times 6 \text{ stems} \times 3 \text{ crops} \times 18\text{lb}}{1{,}000} = 972\text{lb}$ per acre for a year. About the height to which the plant should be permitted to grow, he appears to differ from some of the authorities quoted by Dr. Watson. But he is careful to explain that he has been led to his own conclusion by finding on his own account that, when he grew smaller stems, though the return of peel was longer, the return of fibre was smaller. He goes further, and seems to imply that larger stems, from seven to eight feet, will yield more fibre, though not in the same proportion to the loss of the weight in peel. It is remarkable, however, that his whole view as regards the height to which the stems should reach, is opposed to that maintained in the 61st paragraph of Dr. Watson's report, where the plants of from three to four feet are declared to yield the fibre of the most uniform, finest and most valuable quality.

Kangra a favourable locality for China-grass.

5. This estimate per acre exceeds by 200lb that which Mr. Montgomery gave in 1876, and which is the highest quoted by Dr. Watson. But it will of course be borne in mind that the fibre, thus extracted and cleaned by the hand, has to undergo a further chemical process in which it loses a portion of its weight before it can be subjected to machinery. Mr. Montgomery gives this loss at nine per cent. in fibre prepared by himself, but Dr. Watson estimates it as 25 to 30 per cent. The former ascribes this difference to the steps taken by him in its previous preparation in this country, as compared with those ordinarily taken in the preparation of the purely indigenous species.

6. Mr. Montgomery is sanguine concerning the invention of machinery for the separation of the fibre, even from the green stem, in a state fit at once for the operation of machinery. His reasons are given in paragraphs 21-23 of his report, and though stated in this form they do not

EXPERIMENTAL CULTIVATION OF RHEA.

afford grounds for any confident expectation, yet they make it a matter of regret that he is unable, from want of funds, to make any attempt at experiment in this direction. But it will be observed, in Dr. Watson's report, that the general concourse of opinion is in favour of operation on the dried stems, and not upon the green. And the reasons given for this in the 58th paragraph of the report appear to me, with due deference to Mr. Montgomery's practical experience, to outweigh those urged by him. The description of the working of Mr. Greig's machine, which was tested at Calcutta by Colonel Hyde, serves to show that, up to the present time, no successful machinery for the required purpose has been devised.

Cost of production. (Conf. with pp. 295, 298, and 310.)

7. How essential such an invention is to any success in the cultivation of the plant is seen clearly when we turn to the all-important point of the cost of production. The lowest estimate at which Mr. Montgomery can rate the cost of turning out one ton of the fibre at Kángra is ₹369. The fibre so turned out has not only to be carried to England, but, before it can be manufactured, has to be subjected to a chemical process, apparently involving a further expenditure of 50 per cent. on the original cost, and certainly causing a loss in the weight of the fibre which is variously calculated at from 9 to 30 per cent. This calculation will make its total cost, before it can be applied to manufacture, £54 or 55 per ton at the *very lowest computation*. And when this figure is compared with the considerations contained in paragraph 46 of Dr. Watson's report, the chance of successful competition with flax, hemp, and the China-grown Rhea already in possession of the market, cannot but appear to be somewhat dubious. Nor, as a matter of fact, has there been any return whatever for the capital which has been sunk in this speculation at Kángra during the past twelve years.

£55 a ton.

(Conf. with p. 284.)

8. On the other hand, out of the ₹369, which is the present cost of the fibre at Kángra per ton, not less than ₹247, or 67 per cent., are expended on the process of extracting the fibre by hand labour. Unless, therefore, machinery can be substituted for this method, the hopes of any profitable cultivation of Rhea, far from being increased, will be diminished every year, for it is not likely that the wages in the valley will remain long stationary at their present rates. But the invention of such machinery is surely possible at any moment.

9. The final result of the experiment made at Kángra may be said to show that both the climate and the soil of the valley are admirably adapted to the production of the Chinese variety of the plant reared at a slight expense, and yielding a fibre of a quality inferior to none. But the stems will not bear the plan of retting which can be successfully applied to jute flax or hemp; and the fibre can therefore only be extracted by a slow, laborious and difficult process, which, however remunerative it may be in China, has been proved to be too expensive here for the foundation of a profitable trade. Only let a more expeditious and cheaper method be discovered for this process, and there would be every reason to hope for success in the introduction of a new and most valuable product and trade.

10. The specimen of fibre promised in the concluding paragraph of Mr. Montgomery's report has now been received and accompanies this letter.

KANGRA. Cultivation of China-grass.

CHINA-GRASS—BŒHMERIA NIVEA PROPER (not Indian Rhea).

Its cultivation and preparation for export.

In submitting, for the information of the Government, the results of my experience in the cultivation of this valuable plant, I wish pointedly to note that my remarks refer solely to that variety of the plant cultivated and known in China under the appellation "Tchow Ma." My stock of

plants has been derived from seed procured with great difficulty from that country in 1863.

REPORT ON CULTIVATION IN KANGRA.

2. Whether the variety of the plant known in Assam as "Rhea," or that known as "Rami" in the eastern islands, is identical with the Chinese plant, I do not venture to offer an opinion. The Government of India have apparently adopted the former appellation, "Rhea," in designating the fibre; the American Government have adopted the latter, "Rami." I have not had an opportunity for comparing growing plants of each variety with mine, but I have had many specimens of fibre from each supplied to me, and there appear to me well-marked distinctions between the three, in colour and texture of the fibre.

Seed procured direct from China.

3. At the time I succeeded in establishing the growth of the plant here (1863-64) the tea plantation at Holta was the property of Government, and several Chinese were then employed there. These men recognised my plants with much surprise, and showed me the Chinese method of separating the fibre.

(Conf. with p. 288.)

Propagation of the Plant.

4. *By seed.*—This course must be adopted in some cases, when the germ of the plant has to be carried over great distances; but probably much disappointment will attend the result. To obtain the seed great care is requisite, and a favourable atmospheric season. For this purpose young spring shoots should be carefully reserved in a well-sheltered position. These plants should receive special care and be well manured. During the rainy season they must be kept thoroughly drained, and after that has passed, the ground should be carefully loosened round the plants. If the rains cease early in October, a fair amount of seed may be obtained; but as far as I can judge no amount of care can ensure success, so much depending on the season—a dry one being most favourable for the full development of the seed. The only method of sowing which I found successful was on a gentle hot-bed, under glass, in March and April; the seed scattered over the surface, covered very thinly with sifted earth, and carefully shaded from the sun, until the plants were about three inches high, when sunlight may be gradually admitted. When sufficiently strong they should be planted out a foot apart every way.

(Conf. with pp. 304 and 298.)

5. *By cuttings of the stems.*—The stems should be spring-grown ones allowed to ripen well and not cut until duly ripe. Then divide the ripened portion of the stem where the cuticle has turned fully brown into short lengths, each including three eyes or buds. Cut a quarter of an inch below the bottom bud and as much above the top one, and plant with the centre bud level with the surface. If the weather be damp and cloudy, they will readily strike root, otherwise they will require shading for a week or ten days, the soil being kept moist. As with seedlings, I find a foot apart every way the most advantageous distance, as very few shoots are thrown up the first year.

6. *By division of the roots.*—This is by far the most advantageous and profitable method. The plants for this purpose should be three or four years old. After gathering the spring crop, dig up each plant carefully and remove the earth from the roots. I generally put the mass of roots into running water for a short time; this cleanses them thoroughly, and enables the gardener to see his work clearly. The tuberous portions of the roots will be found to show a large number of eyes similar to those on a potato. From these carefully separate portions, each containing five or six eyes, let the cuts be clean and reject all fibrous and decayed matter. Expose these sets to the sun for a couple of hours to dry the surface of the wounds, and then plant six inches deep, and at the full distance of four feet apart every way. In this way two good crops will be obtained from them the first year.

REPORT ON CULTIVATION IN KANGRA.

7. *Soil and situation for plantation.*—A rich loam suits the plants best, but they will grow in any kind of soil, provided a full supply of moisture be available, combined with thorough drainage. The latter is emergently required, particularly during the rainy season, as should the land be retentive and become swampy the plants will wholly decay in a very short period. If the land be poor, a liberal supply of manure is requisite, otherwise the stems will be short and weak, yielding scarcely any fibre. In no part of Upper India can the plant be successfully cultivated unless water for irrigation be available during the dry season. The facilities for obtaining an ample supply of water, combined with the moderate temperature at all seasons, renders this district particularly favourable to the plant.

8. *Cultivation.*—Should the land have been stocked with seedlings or cuttings (paragraphs 4 and 5), then in the following spring, after having reaped the first crop of available shoots, every other plant should be transferred to fresh ground, and put down at two feet apart. The following year the same course should be pursued, taking up each alternate root and replanting at four feet apart. After this the plants may well remain undisturbed for four years, hoeing well between after each crop, clearing away weeds, irrigating moderately during the dry season, and supplying manure where necessary. The only manure I had at command has been vegetable, consisting mainly of the leaves and wood portion of the plant itself, and of tree and vegetable leaves stored up for the purpose, with which I mix a considerable amount of wood-ashes. With the aid of this only I have kept plants growing in the same spot for upwards of six years; but consequent on the then very crowded state of the ground, the stems were short and very weak. I would therefore recommend a thorough removal after four years, the land to be then well ploughed, cleaned and manured.

9. *Gathering the crop.*—The periods of reaping will vary slightly according to difference of season. I find that in this district three good crops can be relied on each year,—the first during the latter half of April, the second about the commencement of August, and the third about the end of November. It will be found of much advantage to postpone reaping the second, and particularly the third, as long as the condition of the plants will admit. If the third crop be cut in the middle of November, the weather here during the remainder of that month is not sufficiently cold to keep back the new growth; and should the young shoots appear above ground early in January, the frosts which are usual at that period seriously injure them and lessen the spring crop. My own experience indicates that the stems should be gathered so soon as the cuticle shows a clear brown colour for about one-third of the length. At this stage, if the soil be good and the plant healthy, the stems will be clean from butt to point, the leaves of a rich dark green above, and pearly white below, and the branch-buds at the axil of each leaf-stalk just showing. If gathered earlier than this I find the connection of the fibres very weak, and that a considerable portion separates in the operation of scraping the peel. If allowed a further growth, the axillary branches will have been thrown out, which will cause breakages at every point both in peeling and cleaning.

(Conf. with p. 301.)

(Conf. with p. 287.)

10. The average height of stems grown here has been six feet, after cutting off the soft portion at the top. In gathering I supply each coolie with a sharp pruning knife. With this they cut the ripe stems close to the butt; these are removed in bundles by boys to the nearest manure pit. Here the boys cut off nine inches of the top and pass one hand with a gentle pressure from top to butt; this removes every leaf The stems are then placed in clean water from whence the peelers remove them and separate the peel, which is again thrown into water, from which it is withdrawn as wanted by the men who clean it. These lay three or four strips of peel

on a flat board, scrape it a few times on the inner side from butt to point, then turn it over and repeat the scraping, which removes the cuticle: it is then hung up or thrown on clean grass to dry.

11. Taking the distance of four feet apart for fully bearing plants, an acre will contain (allowing for paths and water-channels) 3,000 plants: more than this I find to be too crowded and to increase labour while lessening the actual yield during a four years' period. Thus planted the yield will be a steadily increasing one, and the plants will not show any deterioration.

12. From repeated experimental weighings, I have deduced the following average proceeds from 1,000 freshly cut 6-feet stems:—

(Conf. with p. 305.)

	lb	
Weight as cut	286	
Do. when dried	77·5 = 27	per cent.
Do. fresh peel	83 = 29	,,
Do. dry peel	21·5 = 7·5	,,
Do. fresh wood	203 = 71	,,
Do. dry wood	56 = 19·5	,,
Do. clean dry fibre	18·7 = 6·3	,,
Do. water	208·5 = 73	,,

13. If larger stems, from seven to eight feet be taken, the average is less in the weight of peel, but in the outturn of clean fibre it is slightly greater. With small stems from three to four feet, the percentage of peel is markedly greater, but the return of fibre is barely 35 per cent. Moreover, the extra labour in cutting, peeling, and cleaning these small stems is an important consideration. The crop cut during the rainy season will always contain a larger percentage of water, and that of clean fibre be found rather less, the fibre being also softer than at the other periods of cutting. This I consider due to the fact that at this period the resinous matter in the plant is in a more diluted state, and consequently a greater portion of it is removed during the process of washing and scraping the peel.

14. I have already expressed my opinion against the use of either immature or small stems as likely to give a result inferior both in quality and quantity; yet I am fully satisfied as to the advisability of not only sorting the crop, as cut, according to length of stem when necessary, but I would further recommend that the peel from all stems of five feet and upwards should be divided into two, and the fibre from the upper and lower portions kept distinct. If cultivated as I suggest, the difference in length of the stems at each cutting will be found very small, the monsoon crop always giving the longest stems.

15. Taking the above as a basis for calculation, and knowing that each plant established as I recommend will give at least an average of six stems during the first year, I assume: $\frac{3{,}000 \text{ plants} \times 6 \text{ stems} \times 3 \text{ crops} \times 18\text{lb.}}{1{,}000} = 972\text{lb}$ per acre per annum.

In earlier estimates, calculating on closely-planted crops and stems four to five feet, I was cautious to restrict my estimate to 750lb. per acre, but five years' additional experience has shown me that with proper open cultivation 1,000lb. per acre may be fairly assured.

16. I would now allude to the cost of growing and separating the fibre into a state fit for export. After a careful review of actual outlay, I estimate this as under:—

	R	*a.*	*p.*	
Land rent per acre per annum	10	0	0	
Cultivation ½ man per acre @ R5 per mensem	15	0	0	
Cutting and training stems, two men for three months, @ R4 per mensem each	24	0	0	
Peeling and scraping, seven men @ R5 per mensem each	105	0	0	
Native supervision @ R10 per mensem, for 50 acres, say	2	8	0	
Cost of 950lb of fibre	156	8		=R369 per ton,

REPORT ON CULTIVATION IN KANGRA.

of which R247'5, or 67 per cent., has accrued in the preparation only of the fibre. This outturn has been obtained under the strictest supervision, and I do not think more could be obtained by native hand labour when doing daily work.

17. The best means of reducing the excessive cost of production have been, and are now being, earnestly sought for, and the result is anxiously awaited. Many anticipate that the separation of the fibre may be effected by mechanical means, others that the object may be obtained by chemical processes. Hitherto I think we have been led astray by our knowledge of the Chinese method of preparing the fibre. But, so far as I am informed, the Chinese do not use the fibre in a *spun* state, but that of divided filaments united into threads by manipulation peculiar to themselves. This process would be equally unsuitable and expensive in Europe as that of the first separation of the fibre has been shown to be. We want the fibre in a state in which it can be at once operated upon by machinery and reduced to yarn, and I am deeply impressed by the conviction that this may be accomplished without the aid of any expensive machinery and of the mechanical power requisite to work it.

(Conf. with p. 284.)

18. The plan of retting as applied to flax, hemp, sunn, jute, &c., is stated to have been in some localities successfully employed with China-grass. I have tried it in every manner at my command on the green and dried stem, as well as on the green and dried peel in running water and in stagnant, both cold and heated. The results have been uniformly unsuccessful. From the peel retted in still water, frequently changed, the fibre was cleanly separated and looked well; but after rinsing and drying was worthless, being weak, dull and discoloured. In all other attempts the fibre itself decomposed equally with the resinous matter. I may add that I have succeeded in growing and retting flax here which has been valued in England at £6-5-0 per ton, so that my management in retting could not have been so very inaccurate as to have solely caused my failures in these attempts.

19. When proceeding to England in 1871, I took with me from the produce of this estate, dried stems, dried peel and hand-cleaned fibre. All these I succeeded in getting experimented upon by manufacturers who had been accustomed to working the fibre. I may here remark that Dr. Watson refers to the fibre having been worked up by the aid of machinery used for the preparation of flax and wool. Mine was prepared by the machinery used for the utilising waste silk, and China-grass, in the state in which it is usually imported, goes through precisely the same process, stage by stage. The result of these operations showed clearly that both dried stem and peel could be operated upon, each giving a good clean fibre. My cleaned fibre suffered a loss of barely 9 per cent. in preparing it for the operation of the machines. Dr. Watson estimates the loss at 25 to 30 per cent. I can fully understand this after examining the specimens of Rhea and Rami I obtained in England. These I doubt not were roughly prepared in the manner described in that gentleman's report (page 37, column 2) where a bunch of the peel is tied by one end to a hook and a scrape on each side of each strip is supposed to finish the work. In this procedure a large amount of evaporation must have taken place before each strip of peel had been operated upon. In my procedure there was no opportunity for evaporation until the clean fibre was exposed to the air; and the repeated scrapings on both sides of the ribband of peel, water being frequently applied during the process, must naturally have removed a much larger portion of the gum and resinous matter than the rude procedure stated.

20. With the knowledge at present attained it is evident that, however cleanly prepared, the fibre of China-grass has to undergo a manipulatory chemical process prior to machinery acting upon it. This process involves

REPORT ON CULTIVATION IN KANGRA.

the use of heat, cheap chemicals, and appliances of small cost compared with machinery. I have already endeavoured to show that operating on the plant in its fresh state must be most profitable, inasmuch as under the present system the cost of carriage is reduced to far less than it would be by transport of the produce in any other form not yet known.

21. As this chemical process is the first step enforced on the manufacturer, and by it the fibre loses a portion of its weight, it would evidently be most desirable that the process should be carried out by the cultivator, or in his immediate vicinity, who would thus save 10 to 30 per cent. in cost of transport, besides obtaining a better price for his produce. The results of the experiments made for me in England, showing that clean fibre could be extracted from the *dried peel*, without the aid of machinery, naturally forced upon me the conviction that a similar process would be equally effective on the fresh peel; and as in the latter case the gum and resin would be in a liquid state, they would be far more readily acted upon than after they had been dried and concentrated; therefore that weaker and consequently less expensive solutions would produce the desired effect. I have not had means at my command to procure appliances properly constructed for the purpose, but I have fully satisfied myself of the feasibility of my idea of procedure, and that it will dispense with all costly machinery in the preparation of the fibre in this country, unless it be desired to convert it into yarn, and then weave it, in which case a factory properly fitted must be established.

22. Many years back I recollect reading an account of an instrument or small machine which had been invented in America for the use of basket-makers, by the aid of which one man could peel as many osiers in a day as would formerly have employed a score. One or more instruments of this kind, according to the size of the plantation, would meet our first want, as peeling the China-grass stems even by an expert hand is a slow process. A properly constructed and fitted boiler in which to subject the peel to the action of the chemicals is the next requirement; and some suitable vessels in which to thoroughly wash the cleaned fibre would complete the necessary plant for the factory. The interest on the outlay for these, added to cost of chemicals used, would, I firmly believe, not amount to one-fourth of that of hand labour as at present, and be a small sum compared with the cost of machinery and engine-power to drive it.

23. I fear the above expression of my ideas will be considered very startling, and I should not have ventured at present to promulgate them had not this report been asked for by Government. I have now given my opinions, and, with due deference to those of the many clever men whose attention has been devoted to this subject, I believe they will be found worthy of consideration. I have spent twelve years and utterly exhausted my means in the persistent effort to firmly establish China-grass as an important product of this district, and I still trust that some other individual will benefit by my losses and succeed where I have failed from want of means to protract the struggle.

24. It was my earnest wish to have forwarded a specimen of my fibre prepared in the manner stated, but I have not been able to obtain the necessary materials. Should I do so shortly, a specimen shall be sent.

THE RAM BAGH, KANGRA;
The 24th February 1876.

JAMES MONTGOMERY.

CONCLUDING REMARKS BY THE EDITOR.

RHEA CULTIVATION IN ASSAM.

While Rhea cultivation is referred to in many official publications subsequent to the above selections from the Records of the Government of India, very little information of a definite nature has been brought to

No. 18, POI-RHEA.

ASSAM RHEA.

light regarding the yield of fibre per acre. The following passage from the Agricultural Report of Assam for the year 1885-86 will, however, be read with interest. It confirms in general terms the reports published by the jails regarding their experiments in Rhea cultivation.

"A small quantity of Rhea was grown in the Nowgong Jail during the year under report. The object of the experiment was double. Details as to the cost of producing the fibre were required, and a comparison between the crop as grown in shade and as grown in the sun was wanted. The second object was quickly gained. The plants put down in the shade refused to grow at all and were a total failure. The patch grown in the sun, on the other hand, did well. An area 71′ × 74′ (= 1 k. 3 l.) was planted in the jail garden in the middle of April.

(This highly favourable opinion is opposed in every point to that given on page 295. —Ed).

"The first cutting yielded 3 seers of dried fibre in July. The second cutting yielded 10 seers, 9 chittacks in September. The third cutting yielded 7 seers, 4 chittacks in October. Total yield in six months = 20 seers, 13 chittacks = value (@ R1 per seer) R20-13. The total cost of planting, cutting, and extracting the fibre was R13; consequently on an expenditure of R13 there was in six months a profit of R7-13. When I saw the crop in the middle of December it was nearly fit to cut, and might safely have been estimated to yield one more crop before the following April. Therefore, five crops might be calculated on from the above data in one period of twelve months. But the produce from three crops was 20 seers, 13 chittacks; therefore the produce from five crops would be 34 seers, 11 chittacks. (I have allowed for slower growth in the cold weather by only taking one crop between December and April.) But the cost of cutting and extracting fibre from one crop was R2. Therefore, the cost of the two additional crops would be R4. Therefore, the total expenditure in twelve months would be R17. Therefore the net profits in twelve months would be R17-11, or, roughly, 100 per cent. per annum. Working out the figures for the acre we see that the weight of fibre obtainable would be 911lb, and the cost R222 per annum.

"The above calculation of course applies only to a very small area, and it is exceedingly dangerous to argue from such limited data that profits will necessarily accrue if the undertaking were conducted on a commercial scale. Still, what evidence there is goes to show that Rhea is a profitable crop, and there is no doubt that the climate of the province suits it admirably."

While the brief summary in the foregoing pages gives some of the leading ideas regarding the present position and prospects of the Indian Rhea and China-grass industry, the writer would earnestly desire that the subject of the *Ban-rhea*, the so-called wild Rhea of Assam, be rescued from the neglect into which it has fallen. It seems highly probable that the persons who have interested themselves in Rhea, have committed the error of considering that it was preferable to concentrate their efforts upon acclimatising the Chinese grass-cloth to the plains of India rather than to cultivate the so-called "wild Rhea" of Assam. It would be of vital importance to have Assam Rhea and China-grass grown side by side in Kangra and other localities in order to finally dispose of the question as to their separate or joint adaptability to certain climates and soils.

---

18. Maoutia, Puya, *Wedd.;* URTICACEÆ. (No. 18 in list given at p. 172.)

Sometimes called WILD-HEMP by early writers and also PUA-HEMP.

Vern. Names.—*Pói, púa,* HIND.; *Puya,* NEPÁL; *Kyinki, kienki,* LEPCHA; *Yenki,* LIMBU; *Poi, púa,* N.-W. HIMÁLAYA.

References.—*Brandis, For. Fl., 406; Kurz, Fl. Burma, II., 429; Royle, Fib. Pl., 368; Hannay, Jour. Agri-Hort. Soc., VII. (Old Series), p. 223; Madden, Jour. As. Soc. Beng., XVIII., I., 622; Gamble, Man. Timb., 323.*

No. 18. POI-RHEA.

Habitat.—A native of the Himálaya (ascending to 4,000 feet in altitude), distributed from Kumaon and Garhwál eastward to Nepál, Sikkim, the Khásia hills, and the Assam Valley to Burma, the Straits, and Japan.

Botanical Diagnosis.—In order to enable collectors to recognise this plant, the following brief description may be here given:—Branches with long soft hairs. *Leaves* alternate 3—6 inches long, elliptic, long-acuminate, dentate with large teeth; beneath white with densely matted hairs; 3-costate. Panicles shorter than the petioles, dichotymous composed of mixed unisexual flowers, the females devoid of a perianth, but possessing a penicillate stigma. Nuts triquetrous. **Dr. Forbes Watson**, in his Report on Rhea, gives a good plate of the plant which was reproduced in the *American Agriculturist* of January 1884 as a figure of **Bœhmeria nivea.**

Fibre.—Although many authors refer to this fibre and state that it closely resembles Rhea, and may be prepared and used in the same manner, yet no one seems to have performed independent experiments with the *poi* fibre, and the available information is, therefore, of an indefinite nature. **Dr. Campbell's** account of the fibre published in **Royle's** *Fibrous Plants*, p. 368, is the only complete account available up to date. The following extract will be found interesting:—

"*Description.*—The leaf is serrated, of a dark green colour above, silvery white below, not hairy or stinging; and has a reddish pedicle of about three inches long. The seed forms in small currant-like clusters along the top of the plant, and on alternate sides about an inch apart. Two small leaves spring from the stem at the centre of and above each cluster of seed.

"*Habitat.*—The *pooah* is not cultivated but grows wild and abundantly in the valleys throughout the mountains of Eastern Nepál and Sikkim, at the foot of the hills skirting the Terai to the elevation of 1,000 to 2,000 feet; and within the mountains up to 3,000 feet. It is considered a hill plant, and not suited to the plains or found in them. It does not grow in the forests, but is chiefly found in open clear places, and in some situations overruns the abandoned fields of the hill people within the elevations which suit it. It sheds its leaves in the winter, throws them out in April and May, and flowers and seeds in August and September.

Not suited to the plains.

"*When Used.*—It is cut down for use when the seed is formed; this is the case with the common flax in Europe. At this time the bark is most easily removed and the produce is best. After the seed is ripe it is not fit for use, at least it is deteriorated.

"*How Prepared.*—As soon as the plant is cut, the bark or skin is removed. This is very easily done. It is then dried in the sun for a few days; when quite dry, it is boiled with wood-ashes for four or five hours; when cold, it is beaten with a mallet on a flat stone until it becomes rather pulpy, and all the woody portion of the bark has disappeared; then it is well washed in pure spring water and spread out to dry. After exposure for a day or two to a bright sun it is ready for use. When the finest description of fibre is wanted, the stuff, after being boiled and beaten, is daubed over with wet clay and spread out to dry. When thoroughly dry the clay is rubbed and beaten out; the fibre is then ready for spinning into thread, which is done with the common distaff.

"*Uses.*—The *Pooah* is principally used for fishing nets, for which it is admirably adapted on account of its great strength of fibre and its extraordinary power of long resisting the effects of water. It is also used for making game-bags, twine and ropes. It is considered well adapted for making cloth, but is not much used in this way.

"**Dr. Falconer** recognised the *Pooah* as the **Bœhmeria frutescens**, *Don*, of Botanists, common at lower elevations on the Himálayas from

No. 18, POI-RHEA.

Garhwál to the Sikkim hills (Ganges to Burrampooter). In the outer hills of Garhwál and Kumaon it is called *Pooee*, and the tough fibre is used there for making nets. In Darjeeling, **B. frutescens** goes by a similar name. *Pooah* and the fibre is used for similar purposes. It was first described by **Thunberg**, who distinguishes it from the textile species, **Bœhmeria (Urtica) nivea**, which grows there in abundance.

"**Captain Thompson**, to whom the specimens of the *Pooah* fibre were sent, says of it, that 'when properly dressed, it is quite equal to the best Europe flax, and will produce better sail-cloth than any other substance I have seen in India. I observe from **Dr. Campbell's** communication, that mud is used in the preparation, which clogs it too much, &c. My Superintendent, **Mr. W. Rownee**, who understands the nature of these substances, tells me that if potash were used in the preparation (which is invariably done with Russian hemp and flax) instead of clay or mud, that the colour would be improved, the substance rendered easy to dress, and not liable to so much waste in manufacturing.'" (*Royle's Fibrous Plants, 368—370.*)

An early suggestion to use alkali in separating the fibre.

The above quotation regarding MAOUTIA PUYA and the incidental allusion to it in the foregoing remarks regarding Rhea has very nearly recorded all that has to be said. The large bale of the fibre shown at the Colonial and Indian Exhibition, and which was obtained from Assam, was either, as **Messrs. Cross and Bevan** suspect, a badly-prepared sample or the fibre is quite worthless. The former explanation would be in accordance with all previous reports, for, although admittedly inferior to Rhea, it would be hard to believe that a fibre so popular with the Assam fishermen could be so utterly worthless as **Messrs. Cross and Bevan's** analysis would make it out to be. The following demonstrates the results of their chemical examination of the fibre :—

(Conf. with p. 289.)

Moisture	11·2
Ash	8·2
Hydrolysis for 1 hour in 1 p. c. Na_2O	62·7
Cellulose	32·7

According, therefore, to **Messrs. Cross and Bevan's** observations, MAOUTIA PUYA would be the least worthy fibre in India, since it has the next to the lowest amount of cellulose and loses more of its weight under hydrolysis than any other fibre examined by them. In their remarks regarding the fibre, however, these distinguished chemists affirm: "A large bale of this fibre was shown at the Colonial and Indian Exhibition, and by experts pronounced identical with Rhea. It now remains to be carefully ascertained in India whether there would be any advantage in cultivating this plant in place of **Bœhmeria nivea**. We can only repeat what we have said elsewhere, that every effort should be put forth in India to ascertain the peculiarities of every plant allied to Rhea. In some respects the true Rhea is too strong, and a Rhea-like fibre, a little inferior in point of quality, that could be more easily cultivated and more cheaply separated from the twigs, would in all probability prove a more profitable and more acceptable fibre than Rhea, which has occupied, and justly occupied, the minds of experts for the last few years.

Doubt thrown on Poi-fibre being of the high merit usually stated.

"The specimen of this fibre exhibited was very inferior in many respects. It is introduced here, as presumably its rightful place, when normally prepared.

"Not only was the specimen inferior in point of preparation (*vide* Analysis, Division D), but it was found in the microscopic examination impossible to isolate the ultimate fibre, by reason of its breaking up under the needles. Many of the fibres of the URTICACEÆ show this tendency to brittleness; but with special attention to cultivation and the conditions of growth, these defects can, in all probability be removed."

No. 21. BAN-RHEA.

It is needless to add anything further except perhaps to emphasize what has already been said—namely, that if Messrs. Cross and Bevan's analysis be confirmed as representing the fibre, an effort should be made to replace its cultivation in Assam and Nepál with the true Rhea or the China-grass cloth, or at all events to see that consignments of *Poi* are not sent to Europe under the name of Rhea.

Museum Samples.

This is a subject that would seem well worthy the attention of the Assam Government, and it would be highly desirable to possess authentic and carefully-prepared samples of *poi* for the collections of fibres presently being made. These should, if possible, be accompanied with a dried botanical specimen of the plant from which they have been prepared in which care should be taken to select a twig showing the flowers or fruits in addition to the leaves.

[CACEÆ.

21. Villebrunea integrifolia, *Gaud.; Fl. Br. Ind. V., 589;* URTI-

Syn.—URTICA ACUMINATA, *Roxb.*; OREOCNIDE ACUMINATA, *Kurz.*; URTICA APPENDICULATA, *Wall.*; VILLEBRUNEA APPENDICULUTA, *Wedd.*

Vern. Names.—*Ban rhea,* ASSAM; *Lipic, lipiáh,* NEPAL; *Kaphitic,* LEPCHA.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 657; Gamble, Man. Timb., 325; Kurz, For. Fl. Burm., II., 427; Jour. Agri-Hort. Soc. (Old series). VI., 184; Jour. Agri-Hort. Soc., VII., 222; Cross, Bevan, King, and Watt's Report on Fibres of India, p. 34.*

Habitat.—A small tree or large bush met with in the East Himálaya, distributed to the Khásia Hills, Assam, Burma, Manipur, and Chittagong. According to Stocks it also occurs in the Deccan Peninsula from the Concan southwards (*Fl. Br. Ind.*). It grows quickly and stands being coppiced freely, but luxuriates best near streams.

Botanic Diagnosis.—An evergreen small tree or large bush. Branches more or less pubescent. Leaves alternate sparingly pubescent or almost glabrous beneath; 6-14 inches long, broadly lanceolate to oblong abruptly acuminate, penninerved, *entire,* almost obtuse at the base. Flowers small, sessile, minutely hispid, forming short, pubescent, dichotomously branched cymes, *in the axils of the leaves* (*Flora of British India says "below the leaves"*).

The *Flora of British India* reduces **Oreocnide sylvatica,** *Miquel,* to be a variety, **sylvatica,** of this species. That form is said to occur in Sikkim, Assam, Burma, the Andaman and Nicobar Islands, the Western Ghâts and Ceylon (*Conf. with remarks at page 319*).

21. V. frutescens, *Bl.; Fl. Br. Ind., V., 590.*

Syn.—URTICA FRUTESCENS, *Thunb.; Roxb., Fl. Ind.*; MOROCARPUS MICROCEPHALUS, *Benth.*

Vern. Names.—*Gar tushiara, poi dhaula, phúsar-putta, kagshi,* KUMAON; *Kirma,* NEPAL; *Takbret,* LEPCHA. This seems also to be the *Mesaki* fibre of many writers on the resources of the Panjáb.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 656; Royle, Fib. Pl., 365; Jour. Agri-Hort. Soc., VII. (Old series), p. 217; Brandis, For. Fl., 406; Gamble, Man. Timb., 325; Atkinson, Him. Dist., 798.*

Habitat.—A more western (or less moisture-loving) species than the preceding, being distributed from Simla to Sikkim, Bhutan, and Assam Shillong); ascending from the foot of the hills to altitudes of 5,000 feet, but found also in Japan and China. Beddome in his account of **Oreocnide sylvatica,** *Miq.* (*For. Man., ccxxv.*), states that **Villebrunea frutescens is** "a

No. 21. BAN-RHEEA.

small undershrub (with 3-nerved leaves) found on our Western Ghâts." O. sylvatica, he informs us, is "common in Coorg and on the south Canara Ghâts; also in Ceylon and Java." Mr. Atkinson remarks V. frutescens "occurs in the neighbourhood of Naini Tál and Bhím Tál and along the valley of the Sarju and Ganges. It has the appearance of a small bambu and grows six to eight feet, varying in the thickness of the stem from the size of a quill to that of the thumb. It is cut down for use when the seed has formed."

Botanic Diagnosis.—A small tree with slender branches, pubescent, faintly angled. Leaves 3-5 inches long (with a petiole 1-2 inches long), thin, drying dark; ovate or elliptic oblong, acuminate, *serrate*, white beneath, 3-nerved, the lateral nerves prolonged for two-thirds the length of the leaf. Flowers dicœcious, in sessile or sub-sessile compact heads, *below the leaves*, and numerous bracteoles between the flowers. Fruit composed of many dry ovoid nuts surrounded by the connate half-fleshy involucre.

Villebrunea Fibre.

Both the above-mentioned plants are reputed to yield highly valuable fibres, and it is probably the case that they are of equal merit. At all events, the two plants are very nearly allied, and when both occur in the same locality are most probably not separately recognised by the natives. The former is if anything a more tropical plant and prefers the damper eastern tracts of the Himálaya, whereas the latter takes the place of that species in the drier areas, and is distributed as far to the north-west as the basin of the Upper Sutlej. Gamble describes the fibre as "brown in colour, strong and flexible, is made in Sikkim and Assam, into ropes, nets, and coarse cloth. The tree is of quick growth and coppices easily, and the fibre is likely to prove valuable." Kurz makes a much more startling statement. "This is the *ban-rhea* of the Assamese, which yields the fibre called China-grass cloth." *Spons' Encyclopœdia* publishes a fact of the greatest importance (*p.* 932); speaking of Villebrunea integrifolia, the writer of that article says: "The fibre is more easily separated than that of the preceding (Maoutia Puya), and is considered one of the strongest in India."

Fibre easily separated.

Royle throughout the whole of his admirable Chapter on Rhea (*Fibrous Plants of India*) alludes repeatedly to *Bon Rheea* or "Wild Rheea." In a special report on "Rhea Fibres in Assam and Hemp in the Himálaya" submitted to the Board of Directors of the Honourable East India Company in 1853, Royle urges that every effort should be made to develop a trade in (*a*) the *Kunkhura* of Rungpore, Dinagepore, &c., which he says is also the *Pan* of the Shan States, and in (*b*) the *Bon Rhea* of Assam. The writer has read all the passages descriptive of the latter with the greatest care so as to avoid, as far as possible, raising false hopes, through falling into mistakes regarding the remarkable fibre Royle designates as *Bon Rheea*. Compiling from the writings of others must necessarily be a less satisfactory procedure than reporting the results of original experiments such as those performed by Roxburgh or by Royle. The possibility of falling into misinterpretations meets one on every hand, and the feeling of uncertainty is only equalled by the consciousness that we have no modern authorities from whom information can be culled that for a moment could be compared with those who wrote the greater part of a century ago. (Roxburgh's experiments with Rhea, for example, were performed in 1805.) The necessity for care, in deciding what Royle meant by *Bon Rheea*, will be at once apparent from the following table as given by the author of the *Fibrous Plants of India*, the more so since he remarks "the specimens were very care-

No. 21. BAN-RHEA.

fully prepared by George Aston, and their strength tried in the office of the Military Store."

	Broke with a weight in lb of
Petersburgh Clean Hemp	160
Yercum (Calotropis gigantea)	190
China-grass, from China	250
Rheea fibre or China-grass from Assam	320
Wild Rhea, also from Assam	343

Hemp from Kote Kangra bore 400 without breaking.

An important point hitherto overlooked.

Now according to this result the *Bon-rhea* of Assam is a stronger fibre than either Rhea or China-grass. Turning to Royle's work to discover the source of this fibre, there would appear to be little room for doubt that the *bon-rhea* fibre he experimented with was obtained from Villebrunea integrifolia. The following account of his *bon-rhea* may be reproduced entire (*p. 363*):—

"Bon Rheea, Wild or Jungle Rheea, Bœhmeria species."

"In the preceding observations, the *Bon* or *Bun Rhea*,—that is, Jungle Rhea,—is so called as if it were the Dom Rhea or China Nettle in a wild state. Of this there is no proof, but considerable probability that it is a distinct species, possessed of many of the same properties as the Ramee or Rhea Nettle. Indeed, Major Hannay, who has chiefly brought it into notice, says of Bon or Jungle Rhea (Bœhmeria species) that it is a jungle plant, common in the Assam forests, and thriving best in the vicinity of water or of running streams. When unmolested it grows to a tree, but, by proper management, any quantity of young shoots can be obtained; and as the divided roots afford numerous shoots, the plant can be propagated by slips as well as by the seed. Its cultivation for its fibre might be carried on as with the willow in Europe.

"By the Chinese in Assam, it is said to be exported into Southern from Northern China. It is cultivated largely by the hill tribes north-west of Yunnan, and by the Singpoos and Dhoanncas of our own north-eastern frontier, to a small extent only, for a coarse cloth, but chiefly for nets. The Nepaulese recognise it as the *Leepeeah* of Nepaul."

"This fibre, in the state in which it has been sent, is well adapted for rope-making. It is about five feet in length, brown in colour, strong and flexible. Capt. W. Thompson, of the house of Messrs. Thompson, Rope-makers, of Calcutta, says of it: 'It is all that can be desired either for canvas or lines, and only requires to be known to be generally used for such purposes.' It was this fibre which was made into a 5-inch rope by Messrs. Huddart along with the Dom Rhea or China-grass, and broke with a weight of about nine tons, or precisely 21,025lb. Since then, it has been made up into ropes of various sizes, which have been carefully tested, and found in every case greatly to exceed in tenacity those made of Russian hemp of the same size." (Here a reference is given to the table of results which has been reproduced above.) "It has been also made up into lines and cords, some of them almost fine enough for fishing-lines: in all which it displays its fitness for all such purposes from the union of strength and flexibility." This is almost word for word Major Hannay's description [*Jour. Agri-Hort. Soc., VII. (Old series), p. 222*], and further on the Major alludes to the *Mesakhee* fibre which he says is obtained from a plant very similar to the *Bon rheea*. This would thus appear to be Villebrunea frutescens.

No. 21, BAN-RHEA.

At page 373 of his work Royle gives the following table:—

Stronger than Rhea.

Fibre.	Size of rope.	Total No. of yarns.	Strength of rope in lb.
Wild rhea, 1st experiment	$4\frac{7}{8}$	132	19,032
Ditto, 2nd experiment	$4\frac{1}{2}$	132	21,025
Rhea fibre	$4\frac{1}{8}$	132	20,488

This then is the *Bon-rheea* which Royle extolls so highly. It grows into a *tree* when not molested; it is called *Ban-rhea* in Assam: *lípiah* in Nepál: and it yields a brownish fibre. That would seem a description of Villebrunea integrifolia and not of any of the Bœhmerias or of Maoutia, and Royle's information was not compiled in London from numerous sources, it was directly taken from the writings of Major Hannay, a gentleman whose name is so intimately associated with the development of the resources of Assam, that it is practically impossible to suppose him to have been mistaken. The samples of the fibre tested by Royle were obtained from Major Hannay so that there would seem to be no possible mistake except the mistake made by all subsequent writers of ignoring the independence of *Ban-rhea* from Rhea itself. Here then the generic name Rhea has probably succeeded in diverting public attention from this most valuable fibre, and it is just possible Kurz may after all be correct. The China-grass from northern China may be the fibre from this plant, and the China-grass from the south, the Rhea or Ramie, of India and of the Straits.

(Conf. with p. 299.)

(Conf. with p. 285.)

Be that as it may we have remained too long ignorant of the properties of the fibres allied to the Rhea of commerce. If all Royle has said, nay even if half what he has said, of this fibre be correct, the future may be expected to largely displace Rhea by the neglected *Ban-rhea* of Assam. That plant could be much easier cultivated than Rhea or China-grass, since it does not require the same damp sub-tropical climate. It is abundunt throughout the Lower Himalaya and luxuriates on exposed hot valleys if only its roots have access to the damp soil of streams. It probably might not succeed well on the plains of India, since it may be found unable to withstand the extreme heat of the summer, but at all events its cultivation along canal courses should be experimentally tested. Even, however, were the plant found unsuited to the plains, its cultivation could be extended throughout the Himálayas and on all the mountain tracts of India, more especially in Assam, Burma, and on the Western Ghâts. It is, in fact, much to be regretted that our experiments in testing the merits of Rhea-machinery were not extended to the allied fibres. It is just possible the difficulties offered by Rhea and China-grass do not exist with Villebrunea, but we should not at least be ignorant of this point, and, as cited above, we have the authority of one writer in thinking the fibre will be found to be more easily prepared than the *poi-rhea*.

Recommended for cultivation.

(Conf. with p. 316.)

Modern experiments with Villebrunea fibre cannot, however, be discovered. No authentic samples of the fibre were shown at the Colonial and Indian Exhibition. The old delusion apparently prevailed so strongly, with the gentlemen who made the fibre collections, namely, that Rhea and *ban-rhea* were essentially species of Bœhmeria, and hence no trustworthy collections of the fibres from the allied Rhea plants were furnished. And that not because they were unobtainable, but rather in consequence of undue attention having been given to the species of Bœhmeria.

The writer cannot, therefore, commend in too strong terms the Villebrunea fibres to the attention of merchants and planters interested in Rhea.

No. 21. BAN-RHEA.

These plants could be grown as hedges throughout the whole tea and coffee districts of India and might afford annually two or three cuttings of fibre-yielding twigs practically at a nominal cost. Manufacturers who may think the grounds for the high expectations here held out sufficiently justified to warrant their embarking in experiments, would find little difficulty in having a ton or two of the twigs collected, dried, and baled to Europe, or even decorticated locally. The species most highly commended (**V. integrifolia**) is a plentiful jungle bush in Burma, Assam, Bengal, and the North-West Provinces. On the lower Himálaya and the mountain tracts of these provinces one or other of the species abounds. That they yield admirable fibres we have the testimony of all modern observers (**Brandis, Kurz, Gamble, &c.**), but that they deserve to rank with the best Rhea, as Royle's *Ban-rhea* would appear to do, is a point which future reinvestigation can alone establish. But this at least seems undeniable, they deserve to be rescued from the generic oblivion of "Rhea." Before leaving the subject of the **Villebrunea** fibres it may be as well to caution intending planters that there are several plants remarkably like the **Villebruneas** all of which yield good fibres though apparently inferior to those obtained from the *Ban-rhea*. In connection with the preparations for the Colonial and Indian Exhibition the Manager of the Glen Rock Fibre Company was good enough to forward to the writer botanical specimens and small samples of the fibres obtained from a few of the allied Rhea plants with which that Company was then experimenting. The following determination of these plants may be of interest, the more so since one or two of these belong to the class that might be mistaken as species of **Villebrunea**.

1st.—Two samples marked **Urtica tenacissima.**

These appear to be large forms of **Bœhmeria nivea**, the China-grass and not of **Bœhmeria tenacissima**, the Rhea as accepted by the writer.

2nd.—A sample marked *Oreocknide.*

This is **Villebrunea sylvatica**, *Blume.*, a plant regarding the fibre of which we have no information. Whether superior or inferior to **V. integrifolia** is a point which can alone be solved by comparative tests. The present plant may be recognised by its glabrous leaves (except on the veins below) and sessile small heads of flowers. (Conf. with the remarks at page 315.)

3rd.—A sample marked *Yaumúrí nar.*

This is **Trema amboinensis**, *Bl.*, a fibre-yielding plant very inferior to the **Villebruneas.**

4th.—**Debregeasia velutina (Conocephalus niveas**, *Wight*)—the *Capsí* of Bombay). The fibre sent along with this seems of good quality. The plant is common in the Concan and Ghât jungles and on the Nilghiri hills, &c.

The last three plants have long leaves with the crowded heads of small flowers and to a non-botanist *might* be mistaken for **Villebrunea integrifolia.**

5th.—**Girardinia heterophylla, var. zeylanica.**

The Nilghiri nettle.

The specimen No. 4 is more likely than any other plant to be mistaken for a **Villebrunea—Debregeasia velutina.** It is the **Conocephalus niveus**, *Wight*, and other writers, and of the allied rhea fibres is the one best known in South India.

The reader is referred to the Dictionary article on the species of **Debregeasia** (under which also will be found **Conocephalus**), but as a popular eye-mark it may be said that the **Debregeasias** are erect bushes having small densely tomentose leaves, and sessile flower-clusters, the females through the succulent growth of the perianth forming edible minute fruits that become agglomerated together like lac around the twigs. The

No. 19, RAJMEHAL BOWSTRING.

Villebruneas and also **Conocephalus** have the flowers borne on short flower-stalks, and in the former the leaves are large but not silvery tomentose below and the margins almost entire, instead of being minutely and sharply serrate as in the **Debregeasias**, while the species of **Conocephalus** are climbing shrubs with the leaves quite entire.

Although the fibre obtained from the **Debregeasias** is most probably very inferior to that of the **Villebruneas**, the plants are more hardy and might with advantage be propagated all over India. They occur on the margins of neglected fields, especially along the foot of the Himálaya and in South India; they ascend the hills to 7,000 feet. Dense undergrowths of these plants exist in the shady glades of the Himálaya, causing the hill-sides, with the ripplings of a gentle breeze, to appear as if sprinkled with snow. A perfectly inexhaustible supply, therefore, of **Debregeasia** fibre might be obtained.

The record of a **Conocephalus** fibre resting on a mistaken identification all reference to that genus was omitted from the *Dictionary of the Economic Products of India*. No authentic information exists as to any of the species of **Conocephalus** being used by the people of India, though they doubtless possess strong fibres like most other Urticaceous plants. The fibre of **Debregeasia velutina** (the **Conocephalus niveus** of certain writers) is, however, of such high merit as to deserve special notice, and it should be critically examined along with **Villebrunea** fibre, since of the **Debregesias** that plant could be better grown on the plains of India than any of the **Villebruneas**. A sample of this so-called **Conocephalus** fibre was sent to England in 1883 by the Glen Rock Company and is said to have been valued at £70 a ton. If even half that sum could be realised it would pay handsomely to cultivate the plant, and as with **Villebrunea** it is probable that the separation of the fibre would be easier than that of Rhea or China-grass. Both these plants possess a property of great merit; they are small trees that stand coppicing freely, and might, as already urged, be grown by the coffee and tea planters as hedges and also in the deeper nullahs where tea and coffee cannot conveniently be grown. Once planted they would require little or no care and would yield a valuable crop of fibre and willow-like twigs for basket-making which might be profitably used on the estate, while the surplus would find a ready sale.

19. Marsdenia tenacissima, *W. & A.; Fl. Br. Ind., IV., 35;* Asclepiadeæ. (No. 19 in list given at page 173.)

Syn.—Asclepias tenacissima, *Roxb.*; Gymnema tenacissima, *Spreng.*

Vern.—*Chitti*, Palamow (Chutia Nagpur); *Haba*, Bomb.; *Muruvá-dúl*, Sing.

Royle calls this the Jetee Fibre. It is remarkable that a plant which yields so valuable a fibre and an inferior caoutchouc should apparently be unknown to the people of India. Following the usual line of reasoning based on vernacular names the plant might be viewed as doubtfully a native of India, whereas it is nowhere cultivated and exists only as a wild plant and is undoubtedly a native of this country.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 258; Wight, Ic. Pl., t. 590; Brandis, For. Fl. 333; Kurz, For. Fl., II., 201; Gamble, Man. Timb., 265; Atkinson's Himalayan Distr., 794; Wight, Contributions to the Botany of India, 41; Voigt, Hort. Bot. Cal., 536; Trimen, Cat. Ceylon Pl., 55.*

Habitat.—A climbing plant, distributed throughout the lower Himálaya (ascending to 5,000 feet) from Kumaon to Assam and Burma: also found on the lower hills of Bengal—Rajmahal, Chittagong, &c. The plant is fond of dry barren localities, twining on the bushes and small trees. It might be extensively cultivated.

No. 19. MARSDENIA FIBRE.

On the Himálaya the fibre from an allied species **M. Roylei**, *Wight*, is also extracted and used by the people, but samples of that fibre have never been examined by experts and its properties are therefore not known. The plant is, however, common a little below Simla (and is there known as *Murkula* or *Kurang*) and also eastwards throughout the Himálaya to Sikkim.

Fibre.—There is very little more that can be said regarding this fibre than what has already appeared in No. 12 of the present volume of Selections. In *Spons' Encyclopædia* (p. 982) it is stated: "The bark of the stems yields a valuable fibre, which is extracted by cutting the stems into sections, splitting them, drying them, steeping them in water for about an hour, and scraping them clean with the nails or with a stick. The hillmen simply dry the stems and altogether dispense with retting. About 6lb of clean fibre is a good day's work. The fibres are fine and silky, and of great strength, a line made of them breaking at 248lb dry and 343lb. wet, as against hemp at 158lb and 190lb. It is used locally for bowstrings and for netting." According to **Roxburgh** the plant was discovered in 1800. "During the rains," he says, "the natives of Rajmahal cut the shoots into lengths at the insertion of the leaves, peel off the bark, and with their nails or a bit of stick on a board, remove the pulpy part."

The figures given above in **Spons'** account of the fibre are those first published by **Roxburgh** and the facts appear to have been compiled from **Royle's** account of the fibre (*Fibrous Plants of India*, p. 304). **Royle** justly adds that "the plant is suited for better purposes than rope-making, besides not being eligible for this purpose, from its comparative rarity and mode of preparation. **Mr. Taylor** remarks that it might, however, be easily cultivated (*V. Jour. Agri-Hort. Soc., 1844*, p. 221). One of the chief features of this fibre is its great elasticity, being according to **Royle** the second best of all the fibres in India.

Only a very small amount of this beautiful fibre was shown at the Colonial and Indian Exhibition, but it was universally admired; some of the experts viewed it as a very superior quality of Rhea. According to **Messrs. Cross, Bevan and King's** chemico-microscopic examination of the fibre, it is very considerably superior to Rhea. The following table exhibits the results obtained by these chemists:—

	Moisture.	Ash.	Hydrolysis. (a) (Five mints).	Hydrolysis. (b) (One hour).	Cellulose.	Mercerising.	Nitration.	Acid Purification.	Carbon percentage.
Marsdenia tenacissima	4·5	1·5	6·2	10·1	88·3	4·6	131·0	0·8	44·6
Bœhmeria nivea (Rhea)	9·0	2·9	13·0	24·0	80·3	11·0	125·0	6·5	...
Linum (Flax, European)	9·3	1·6	14·6	22·2	81·9	8·4	123·0	4·5	43·0
Calotropis gigantea .	7·3	2·5	13·0	17·6	76·5	..	153·5	8·5	44·0
Crotalaria (Sun-Hemp) .	8·5	1·4	8·3	11.6	83-0	11·3	150·5	2·7	44·3

To allow of comparison four other fibres have been shown alongside of **Marsdenia** (the Rajmahal-Bowstring). That fibre heads the list in percentage of cellulose and loses considerably less than any of the others, either under hydrolysis with caustic soda or in the acid purification, while it holds the third place in increased weight by nitration. These are facts that cannot be ignored. They point to this fibre as being, from a scientific standpoint, far more worthy of experimental cultivation than **Rhea** or any of the other fibres with which in the above table it has been compared. The one point of uncertainty regarding it, which practical experiments alone can

No. 19. RAJMEHAL BOWSTRING.

solve, is its yield of fibre per acre as compared to the cost of cultivation,—in other words, the price at which it could be put down in the textile markets. The ultimate fibres are 5 to 20 mm. in length, *e.g.*, nearly as long as those of flax, and two or three times as long as those of sunn-hemp or of jute, though of course very much shorter than the fibres of Rhea. But from this point of view Rhea stands by itself, as its ultimate fibres (40 to 200 mm.) are far in excess of any other known fibre. Messrs. Cross, Bevan and King say of Marsdenia: "Next to Rhea it must rank in point of fineness and durability, and we cannot urge its claims to the attention of Government in too strong terms. If it can be shown that the fibre could be cultivated at all, it might then become a question whether the *haba* (*sic*? a vernacular name) or Rhea could be produced the cheapest."

It seems probable that to arrive at good results the long young twigs of the plant had better be treated by some chemical decorticating process, such as that of Favier, instead of being cut into short lengths and decorticated mechanically. The shortness of the fibre-ribbons, as usually met with, would presumably be viewed as unfavourable, but since this is by no means a necessity it might be well to adopt some process of decortication that would produce ribbons the full length of the twigs.

The plant is too scarce and unimportant-looking for its merits to come by the usual "private enterprise" means to be recognised by the manufacturer. It must be cultivated and that too perhaps for a good many years before a final opinion can be pronounced. It is a small climber and does not appear to grow either rapidly or profusely, but there is no knowing what it might do under careful management. It is, however, too valuable a fibre to be longer ignored, and it would serve a public good were the various Botanic Gardens and Agri-Horticultural Societies to take its experimental cultivation under their special charge. Were the cultivation to prove remunerative, the plant might be reared in every hedgerow of India, but being a climber difficulties exist with which the Indian cultivator of fibre crops has not as yet attempted to deal. In order to avoid these difficulties—the expense and trouble of constructing supports for a climbing plant—it would be a good step to ascertain whether it could be induced to crawl over the ground instead of requiring supports. Although, as stated, it might be grown in every hedgerow over the entire length and breadth of the plains of India, success could alone be ensured by the production of a stock that might be planted in the usual way over a limited area.

GEORGE WATT,
Reporter on Economic Products.

Simla, December 1888.

VOL. I.; PART II. (No. 19); 1888-89.

SELECTIONS

FROM

THE RECORDS OF THE GOVERNMENT OF INDIA,

Revenue and Agricultural Department.

BY THE REPORTER ON ECONOMIC PRODUCTS.

The Flosses and Silk-Cottons of India.

HISTORY OF COTTON.

The cotton staple consists of elongated simple cells developed around the seed, and is not, therefore, a bundle of cells or vessel as is the case with the fibres described in these Selections hitherto. Many other seeds, besides those of the cotton plant, however, are similarly surrounded by hairs, and the expression Silk-cottons may have been first applied to the silky coma frequently met with in plants belonging to the two great Natural Orders—ASCLEPIADEÆ and APOCYNACEÆ. In the economy of plant-life these silky hairs would seem to have been designed as wings or floats intended more for the distribution than the protection of the seeds. On reaching maturity, the seed escapes from the fruit, its coma expands in the hot breeze, the seed is lifted into the air and carried for a considerable distance before reaching the ground, where, coming under the influences of germination, it commences to grow and the plant is thus fixed to one spot for the remainder of the term of its existence. Similar structures are found in many plants where the function—a dispersion agent—is clearly indicated. In the dandelion and other COMPOSITÆ, the calyx becomes feathery with the ripening of the fruit, and thus meets the necessities of distribution. The seeds of the Epilobium, of the willow, the poplar, the silk-cotton tree, and of many other plants, are partially or entirely surrounded by hairs. Whatever may be the precise object of these hairs in each individual case, man, in all ages and in nearly every country of the globe, has utilised them for *his* wants. Cotton, as also all the Silk-cottons were, however (in tropical countries at least), first used as stuffing for quilts, mattresses, and pillows, before the art of spinning a short fibre was discovered. It is probable that the first garments of a textile nature were plaited by the hand from long ribbons of bark, or were made of grass. By and by, we may suppose man's inventive art to have suggested the twisting of long fibres such as those of hemp, flax, jute, or *sanai* into threads which were afterwards plaited or woven into textiles. Antiquarian research in temperate countries has brought to light several examples of woollen threads plaited into garments, thereby proving that the art of spinning preceded that of weaving. Indeed, the ancient sculptures of Egypt depict women spinning flax. But the twisting or spinning of short staples, such as cotton and wool, is clearly a higher and more difficult art; and might, therefore, be supposed to have been arrived at during a considerably later period than that of the utilisation of fibres

HISTORY OF COTTON.

(natural threads) often 5, 10, or 20 feet long. In high latitudes the inhabitants of cold regions seem, however, to have early discovered the art of twisting straw into ropes, and of spinning wool by means of the spindle and the distaff. Whatever may have been the order of early textile invention, it is singular that cotton (if, indeed, it be as botanists affirm, an indigenous plant to India and certain parts of Asia generally), should scarcely find a place in the early classical literature of the East. Nearly all the beautiful and the useful plants of India, if not of Asia, have their properties extolled by the Sanskrit poets or are dedicated to the gods; but cotton—the plant above all others which might be expected to have formed the theme of nature-worship—is passed by with the most incidental references to its properties; and in the modern works only is it noticed in such language as to remove doubt in regard to the plant referred to. Among one or two of the aboriginal races of India, however, it holds a more honourable place than with the so-called Aryan people. The Khonds plant a cotton-bush in the place selected for a new settlement, and in after years the village plant is sacredly tended and watered.

The Sanskrit word translated Cotton is probably first mentioned in the Institutes of Manu, which are believed to have been written 800 years before the birth of Christ. In Book II., No. 44, it is stated that "The sacrificial thread of a Brahman must be made of cotton so as to be put on over his head in three strings; that of a Cshatriya, of *Sana* thread only; that of a Vaisya, of woollen thread." The word used in that passage and translated cotton is *kárpásí* कार्पासी from which has been derived, according to most writers, the modern Hindustani *kapás*, and even the Hebrew *karpás* (the "green hangings" of the Book of Esther—*i. v. 6*). But *Kattan* كتان is an old Arabic and even a Persian word for flax, although, apparently, it gave origin to the European names now in use for cotton, such as Cotone (ITAL.), Coton (FR.), &c. At all events, the Arabs were the first to cultivate cotton in Europe. On the other hand, the Arabic *kurfus* (a word probably derived from the Sanskrit) is often given to cotton, so also *kutn* قطن of the modern Arabic writers, and *punbah* پنبہ of the Persians are now translated cotton. (Conf. with the remarks regarding the word *Kapok* at page 333 and the name *kattyan*, as given to **Eriodendron anfractuosum**). The word *karpason* in Greek signifies cotton, and *carbasina* is even met with in *Statius*, where it is affirmed "cotton cloths" were known to the Greeks as early as 200 years before Christ. The βύσσος of the early Greeks was the fine linen used for making mummy cloths, but by the later writers it was applied to cotton. The words λίνον and *linum* have sometimes been translated "cotton," just as *carbasus* was often rendered "flax." **Yates** (in his *Textrinum Antiquorum*) says that some poets assume a licence in the use of the word *Carbasus*, and **Dr. Robertson** very appropriately points out that doubt may be admissible as to the extent cotton was even known to the Romans, since garments of that fibre are nowhere specified in the laws *de Publicanis et Vectigalibus*, while on the other hand imported spices and precious stones find a recognised place. It may also be viewed as significant that with writers in the third and fourth centuries it was customary to speak of cotton and cotton-goods by names not in use prior to that date. Thus **Pliny** refers to the *Gossypinos* or *Gossypion* of the island of Tylos, and a misapplication of a term derived from silk became general, *viz.*, *Bambacinus* (made of cotton), *Bambacarius* (cotton-dealer), &c. *Bombax* is the generic name given by botanists to the silk-cotton tree.

Whether or not, therefore, these somewhat conflicting usages of the names now given to cotton be accepted as throwing doubt on the original meaning of the Sanskrit *kárpásí*, there remains the remarkable fact that

HISTORY OF COTTON.

the plant which yielded the *kárpási* fibre was in no way held sacred by the ancient Hindus, nor is it so at the present day. But during the age when the Institutes of Manu were penned, spinning and weaving were not only known, but the art of starching or weighting a textile was also practised, and the admissible amount prescribed. In Book VIII., No. 326, it is enjoined that for "stealing thread, raw cotton, materials for making spirituous liquors, &c.," the fine should be twice the value of the articles stolen. Again, at No. 397, "Let a weaver, who has received ten *palas* of cotton-thread, give them back increased to eleven by the rice-water, and the like used in weaving: he who does otherwise, shall pay a fine of twelve *panas*." The picture thus raised before our eyes of the character of the textile industries of India, 2,700 years ago, meets its parallel only in the injunctions laid down for domestic life. Book VIII., No. 396, deals with the regulations regarding washermen. "Let a washerman wash the clothes of his employers by little and little, or piece by piece, and not hastily, on a smooth board of *Sálmali*-wood: let him never mix the clothes of one person with the clothes of another, nor suffer any but the owner to wear them." (For *Sálmali*-wood Conf. with **Bombax** and **Eriodendron** below.) We are thus led to believe that not only was spinning and weaving fully understood, but that a civilisation existed in that remote age when the social habits of the people of India were little different from those of the present day. Accepting as correct the universal interpretation of the early *kárpási* as cotton (a view by no means essentially necessary), we have no alternative but to believe that the art of spinning and weaving was perfectly understood in the East when the inhabitants of the West were ignorant even of the properties of cotton. Indeed, from the date ascribed to the Institutes of Manu, we have to pass over a gap of some 1,500 years before we can be assured that cotton had found its way to Europe, and long by that time the *kárpási* of the then Sanskrit authors was unmistakably cotton. But on its arrival in Europe, cotton, like the indigenous flosses, was first employed in the manufacture of paper. Carrying this sketch down to still more modern times, the art of spinning the short staple was only learnt in Europe when the delicate manufactures of India and Egypt had permeated the whole world. The Italians in the thirteenth century were the first to attempt the imitation of these delicate fabrics. The industry next migrated to the Low Countries, and thence passed over to England in the seventeenth century. **Sir George Birdwood** writes: "In 1641 Manchester cottons made up in imitation of Indian cottons were still made of wool. But in vain did Manchester attempt to compete on fair free-trade principles with the printed calicoes of India; and gradually Indian chintzes became so generally worn in England, to the detriment of the woollen and flaxen manufactures of that country, as to excite popular feeling against them." Well may the cotton princes of Lancashire blush when the law of 1721 is brought to mind—a law which "disgraced the statute book" of Great Britain for fully a generation, since it prohibited calicoes from being worn in the United Kingdom. But this law was modified in 1736 so far as to allow persons to wear calicoes, "provided the warp thereof was entirely of linen yarn;" it was repealed when Great Britain was able to compete in the new trade. Cotton was manufactured in Scotland in 1676; and in Manchester, during the year 1765, the manufacture of calicoes had become an established industry. In the year 1769 the inventive genius of **Arkwright** placed the English manufacturer in a position to dispense with protective regulations, and to be able to embrace the theory of free trade as the war-cry that has since, in the onward march of manufacturing enterprise, placed Britain in the foremost rank among the nations of the world.

Conf. with p. 331.

From what has been said it may be gathered that cotton came slowly at first, then rapidly, to its present position—the most important of fibres—

HISTORY OF COTTON.

and that in its progress, it displaced to a large extent the hemp, flax, and wool which preceded it. But we have abundant evidence that, as with the silk-cottons so with cotton itself, it was first used in tropical countries as the padding for flaxen or hempen quilts. **Linschoten** alludes to a special fibre (probably rhea) which was used in Bengal (300 years ago) for the purpose of sewing garments made of quilts. Such cold-season garments are to this day more common in India than are those made of wool. In cold countries, where wool is generally plentiful, this practice might be supposed to have been less frequently followed, but in nearly every country in the world cotton and the silk-cottons have, from the remotest antiquity, been used for what we now call upholstery purposes, and as such some of the silk-cottons have special properties attributed to them. Thus the floss of **Calotropis gigantea** is supposed to be very cooling, and hence is employed for stuffing the pillows given to sick persons or to children. The silk-cotton of the *semul* tree (**Bombax malabaricum**), while largely used in India for upholstery, is known to be very liable to collect into knots, thus necessitating the stuffing of matresses to be periodically removed, hackled or teaseled, and cleaned. The *kapok* or floss of **Eriodendron anfractuosum** has of late years attained a high reputation on account of its great elasticity, a property that is said to prevent it from becoming knotted as a stuffing. Recently also, renewed interest has been taken in the possibility of spinning these silk-cottons. Past experiments resulted in the verdict that the staples of the silk-cottons were too short and the fibres too light to be spun. These difficulties seem, however, to have been got over, and a future appears to be opening out for two of the Indian flosses—**Calotropis** as a textile fibre and *kapok* for upholstery purposes. Before proceeding to deal with the silk-cottons individually, it may be here added, by way of conclusion to these introductory remarks, that the inferiority of most Indian as compared to American and Egyptian cottons consists in the shortness of the staple. Agricultural improvements, both with cotton itself and any of the silk-cottons, intended for the spinner, should be directed towards discoveries in methods of cultivation, careful selection of seed, or hybridization that would produce a longer staple.

Conf. with p. 333.

Conf. with Dictionary, Vol. I., 632.

22. **Bombax malabaricum**, *DC.*; MALVACEÆ. (*No. 22 in list at page 174.*)

THE RED COTTON-TREE.

Vern.—*Semul* or *sémal, pagun, somr,* HIND.; *Simul, rokto-simul,* BENG.; *Del,* KOL.; *Edel,* SANTAL; *Simur,* MAL. (S.P.); *Bouro, sembal,* ORISSA; *Saldi,* KURKU; *Boichu, panchu,* GARO; *Sunglu,* LEPCHA; *Semar,* C. P.; *Simbal,* HAZARA; *Shirlan,* SUTLEJ VALLEY; *Saur, saer, sawa, somr, semul, sembal,* BOMB.; *Sawari,* DHARWAR & BELGAUM; *Sávara, simlo, samar, shevari* or *shevri, tamari, mocha,* MAR.; *Rato-shemulo, shemolo, shimlo, shimul, shimar, sánovar,* GUJ.; *Kánton-ká-khatyan, kántón-ká-semul, lál-khatyan,* DUK.; *Mundla-búraga,* TEL.; *Mul-ilava, mulilavu,* TAM.; *Pula, mul-lilava,* MAL.; *Mullu-bú-raga,* KAN.; *Burla,* KARNATAK; *Wallaiki, walúki,* GOND; *Katseori,* BHIL; *Lapaing,* MAGH.; *Sálmalí, mocha,* SANS.; *Letpan, didu,* BURM.; *Kattu-imbúl,* SING.

The above is a fairly complete selection of the names given to this plant in most provinces of India, and they have been given here to enable local officers to distinguish the red-cotton from the white-cotton tree—**Eriodendron anfractuosum**—the plant which yields the floss which at the present day is in most demand by upholsterers.

Habitat.—A large deciduous tree, with branches in whorls, spreading horizontally, the larger ones being supported by buttress-like developments of the stem, trunk, and branches enclosed by corky bark covered with great prickles. Flowers very large, bright scarlet or almost white, the latter colour being very rare; the flowers appear when the tree is leafless and sit in tufts erect on the branches.

No. 23, MADAR FLOSS.

The tree is met with throughout the hotter parts of India and Burma, and ascends the mountains to altitudes of about 4,000 feet.

Fibre.—Enough almost has been said regarding the floss obtained from the seeds of this plant in No. 12 of these Selections. It is longer than that obtained in India from the more valuable tree **Eriodendron anfractuosum**, but is more liable to get matted when used for upholstery purposes, and is not near so elastic. It is too short to be spun easily, and is by no means so soft and silky as the floss of **Calotropis gigantea**. While, therefore, for the purpose of the enquiry these notes are designed mainly to stimulate, the *semal* fibre may be disregarded, it would be most desirable to have a representative collection of the *semal* floss obtained from all parts of India, accompanied with such notes and botanical specimens as would enable something to be learned as to the superiority and inferiority of the *semal* flosses from the different parts of India and from the different varieties of the plant that exist.

Museum Collections.

The reader is referred to the remarks under **Eriodendron**, pp. 329-339.

[PIADEÆ.

Conf. with Dictionary, Vol. II., 170.

23. Calotropis gigantea, *R.Br.*, and **C. procera**, *R.Br.*; ASCLE-

Vern.—*Madár, ák, ákond*, HIND.; *Akandá*, BENG.; *Arksha*, ORISSA; *Ahauna*, SANTAL; *Auk*, NEPAL; *Akra, ruí, mandara*, BOMB.; *Akanda, ákda*, MAR.; *Akado, ákdámu*, GUJ.; *Bij-elosha*, SIND; *Yercum, erukku*, TAM.; *Jillédu, jilleru, manduramu, yekka*, TEL.; *Yekka, ekkemále, yokada*, KAN.; *Kadráti*, GOND.; *Tritch gandera, spalmai*, PASHTU; *Spalmei, spalmak*, AFGH.; *Ushar, oshmor*, ARAB.; *Khark*, PERS.; *Arka* (red flowered form), *alarka* or *pratápasa* (white flowered form), *mandára, ásphóta, gonárúpa, vicírana, arca-perna*, SANS.; *Mayo-beng, mayo-máyo-pin*, BURM.; *Vara, múdu-wara*, SING.; *Waduri*, JAVA.

Sir William Jones says that "any name of the *Sun*" may be given to this plant in addition to the above Sanskrit names.

Habitat.—The two species named above are erect, spreading, perennial shrubs which chiefly frequent waste lands. They ascend the hills to about 3,000 feet above the sea, and accepting the two as economically identical they are distributed from the Panjáb to South and West India, Bengal, Assam, Burma, Ceylon, and Singapore,—**C. procera** being also met with in Persia and tropical Africa. The former species occurs in India in the hotter damp areas and the latter in the drier tracts, the meeting-point of the two forms being in the North-West Provinces.

The Fibre or Floss.—The properties of the bark fibre have already been dealt with in No. 13, p. 186, and the experiments recommended to be performed and the amounts of floss required for the present collections have also been indicated in No. 12, & p. 170. There thus remains very little more to be said in this place. The reader is referred to the account given in the *Dictionary of the Economic Products of India*, Vol. II., pp. 38, 39 and 41. According to **Balfour** the natives of Madras make thread from the floss. He adds: The fibre "is susceptible of being spun into the finest yarn for cambric, and has been used for the manufacture of a light substitute for flannel by **Messrs. Thresher** and **Glennie** of London." No effort appears to have been made in India, nor indeed in any other country, to improve the quality and length of the *mudar* floss. **Mr. Moncton** found it difficult to spin the fibre by itself owing to the shortness of the staple, but when mixed with one-fifth of cotton fairly good results were obtained. Subsequent experiments performed by **Messrs. Thresher** and **Glennie** resulted in the report that the staple was so short and light that though they could spin it, the result was not hopeful. As opposed to this verdict another spinner, **Mr. Hollins**, has felt sufficiently satisfied with the prospect of finally being able to utilise the floss and profitably; that he has directed the **Revd. A. Campbell** of the **Santal** Mission to experimentally cultivate the plant and to endeavour

Collections.

No. 23 MADAR FLOSS.

to improve the quality of the floss, while preserving accurate statistics of his experiments, *viz.*, as to cost of cultivation, yield per acre, &c., &c. The writer has just learned from **Mr. Campbell** that his first consignment of floss is now ready for dispatch to **Mr. Hollins**, but that the report on the experiments is not available for publication. There would appear to be no doubt, however, but that this plant richly deserves to be systematically cultivated for a few years even in the face of initial unfavourable results. It yields, in addition to the floss, a fairly good supply of caoutchouc, the root-bark is one of our best Indian medicines, and the bark-fibre **Messrs. Cross, Bevan and King** consider of such high merit as to especially recommend it in the concluding words of their *Report on Indian Fibres.* These gentlemen say: "The most characteristic of the celluloses isolated from the fibres are those of **Calotropis** and **Marsdenia.**" (Conf. with No. 18, page 32.) "For softness and silky lustre they surpass all others that we have examined, and we should be glad to see more attention paid to these fibres, from the technical point of view." It should be observed the "all others" includes the much-talked-of rhea and China-grass cloth.

Reh efflorescence.

A long official correspondence has taken place on the subject of a cure for the injurious *reh* efflorescence so common in many parts of Upper India. At one time it was thought the *madár* plant possessed peculiar chemical principles which would neutralise the reh and thus save the land from the complete ruin which the encroachment of the salt efflorescence threatens. It was subsequently shewn, however, that free irrigation and manuring with *any* vegetable matter containing nitrogen would accomplish that purpose more rapidly and effectually than could be done by the production of *madár* leaves as a special cure. At the same time a point of some importance remains which has a direct bearing on the present question. The *madár* will grow on a reh-impregnated land when very few other plants can be made to do so. The land is thus practically valueless and is threatened with absolute sterility. If the produce of a *madár* crop would pay for the manuring and irrigation necessary for its own cultivation, *madár* might assume a position as a reclamation agent which has not hitherto been contemplated. If this suggestion be supported by experience, the manufacturers of Europe might fairly look for a limitless supply, and the inhabitants of wide tracts of country have removed from their minds the alarming prospect of the fields their ancestors cultivated becoming barren wastes. But even admitting that this theoretical view, on being practically tested, is found less fruitful of benefit to the cultivators or less efftecual than many other courses with which they are already familiar, there remain two facts:—*1st*, vast tracts of country are uncultivated on which the wild *madár* grows. With a little care to encourage more compact and, therefore, more accessible growth, such as by the exclusion of other weeds and the planting of the *madár*, most people in India might get an annual crop of wild *madár* which would supplement their agricultural earnings. The wild plant at present is too scattered to pay for the collection of the floss. It is met with here and there, the plants occurring every 20, 40 or 100 yards along roadsides and through waste places. Let the gaps be filled up by planting shoots every two or three yards apart, and these wild plants would continue to give a return with no further labour than an occasional pruning to produce young flowering shoots. Immense tracts of country have in Madras and Bombay, for example, been taken possession of by the introduced Cactus (Opuntia Dillenia). All effort has practically failed, which the unaided cultivator can put forth against the advance of that determined interloper. Let **Calotropis gigantea** be planted freely through such tracts, and it is highly probable the indigenous plant would be found to hold its own. Such a plantation would give a distinct revenue, while the land presently occu-

pied with the Cactus is valuless. But the *2nd* consideration remains. The bark-fibre of *madár* is so immensely valuable that, taken in conjunction with the floss, experiments towards improvement have only to be successfully performed when it might pay the cultivator to devote even his best lands to this plant. No. 23, MADAR FLOSS.

Nothing more, therefore, need be said in the present note. It rests with persons who have the time, money, and inclination to realise the full benefits of this new commercial product or prove the writer's expectations sanguine and unfounded.

24. Cochlospermum Gossypium, *DC.;* BIXINEÆ. (*No. 24.*)

THE YELLOW COTTON TREE (a name denoting the colour of the flower). Conf. with Dictionary, Vol. II., 1512.

Syn.—BOMBAX GOSSYPIUM, *Linn.; Roxb., Fl. Ind., Ed. C. B. C.*, 515.

Vern.—*Kúmbi, gabdi, ganiár, galgal. gangal,* HIND.; *Hopo,* SANTALI; *Galgal,* KOL.; *Gangam,* GOND; *Kontopalás,* URIYA; *Kúmbi,* PB.; *Gajra, kúmbi,* N.-W. P.; *Gúngú, kong, gondu-gogu,* TEL.; *Tanaku, kongillam,* TAM.; *Betta tovare, arisina burga,* KAN.; *Chima-púnji,* MAL.; *Ganerí,* BHIL.; *Ganeri, gunglay, kathalyá gonda,* MAR.; *Katira-i-Hindi,* PERS. and HIND. Irvine gives the plant the name of *narfaris.* The Floss bears the following names:—*Pili-kapás-kirui, katéré-ké-ghúr-ki-rui,* DEC.; *Tanaku-parutti,* TAM.; *Konda-gogu-patti,* TEL.; *Shima-pangi-parutti,* MAL.

Habitat.—A small deciduous tree, with short, thick, spreading branches; grows in the forests at the base of the North-Western Himálaya, from the Sutlej eastward to Central India, Bundelkund, Behar, Orissa, and the Deccan; also in the Prome district of Burma. Is commonly planted near temples. When the tree is devoid of leaves (in March to April) it bursts into its handsome large yellow flowers, its pendulous, pear-shaped fruits ripening before the new leaves appear.

Fibre.—The seeds possess a short but very soft and elastic floss, from which fact the plant has received its specific name. This floss is much too short to be of any service as a textile fibre, but, with the flosses of **Bombax malabaricum, Eriodendron anfractuosum,** and **Calotropis gigantea,** it has been classed as a "Silk cotton." By some writers these have recently been designated "Kapok fibres," but there is every reason to believe that the true kapok of the Dutch upholsterers is the floss of **Eriodendron anfractuosum** (*see* the *Dictionary,* Vol. I., B. 641). In some parts of India the floss of this tree is collected and used for stuffing pillows, for which purpose it would seem better suited than the floss from **Bombax malabaricum,** as it is not so liable to get matted. It might be found serviceable as a gun-cotton. (Conf. with the *Dictionary* article, Vol. II., C. 175, and with **Kapok** in a further volume.)

The **Rev. A. Campbell** states that the Santals prepare a good, useful cordage fibre from the bark of the tree. In the report of the Conference held on Indian fibres, at the late Colonial and Indian Exhibition, it is stated that **Mr. Campbell's** fibres from this tree were much admired, the floss being viewed as possessing the merit of elasticity—a merit which might allow of its competing favourably with the true kapok.

25. Eriodendron anfractuosum, *DC.; Fl. Br. Ind., I., 350;* MALVACEÆ. Conf. with Dictionary, Vol. III.

Syn.—BOMBAX PENTANDRUM, *Linn.;* B. ORIENTALE, *Spreng.;* CEIBA PENTANDRA, *Gærtn;* ERIODENDRON ORIENTALE, *Stend.;* E. RHEEDII, *Planch.*

Vern.—*Hattian, katan, saféd-semal,* HIND.; *Shwet-simul,* BENG.; *Ilavam,* TAM.; *Búraga, púr, buraga-sánna,* TEL.; *Paniá, paniala,* MAL.; *Khatyán, suféd-khatyán,* DUK.; *Katsávar,* KANDESH; *Shamieula, saphetasávara, sálmali, pandhari, savar,* MAR.; *Bili burga, bili-barlu,* KAN.; *Imbul,* SING. (*elavum, illaku,* TAM., in CEYLON); *Thinbawle,* BURM.

No. 25. KAPOK.

References.—*Roxb., Fl. Ind., Ed. C. B. C., 613; Voigt, Hort. Sub. Cal., 106; Grah., Cat. Bomb. Pl., 17; Dals. & Gibs., Bomb. Fl., 22; Wight & Arn., Prod., I., 61; Wight, Ic., t. 400; Griff., Not., IV., 533; Beddome, Flor. Sylv., XXX., and Anal. Gen., t. 4; Hamilton (Gossypinus) in Trans. Linn. Soc., XV., 126; Thwaites, Enum. Ceylon Pl., 28; Kurz, For. Fl. Burm., I., 131; Moodeen Sheriff, Supp. Pharm., 135; also (new work, proof sent to author) Mat. Med. South India; Gamble, Man. Timb., 42; Lisboa, U. Pl. Bomb., 195 and 229; Gray, Botany of Bombay in Gazetteer, XXV., 322; Baden Powell, Pb. Prod., 333; Murray, Pl. and Drugs of Sind, 56; Drury, U. Pl. Ind., 197; also Handbook Fl. Ind., I., 86; Cooke, Gums and Gum-resins, 34; Ainslie, Mat. Ind., II, 96; Balfour, Cyclopædia of India, 1053; O'Shaughnessy, Beng. Disp., 227; Dymock, Mat. Med. West Ind., 2nd Ed., 106; Rheede, Hort. Mal., III., t. 49, 50; Rumph., Amb., I., t. 80.*

Habitat.—A tall tree with straight trunk, prickly when young; branches horizontal and whorled. Flowers dirty white and much smaller than those of **Bombax**, with staminal tube splitting into five portions each with two anthers instead of into many divisions each with one anther as in **Bombax**.

According to the *Flora of British India* this tree occurs "in the forests throughout the hotter parts of India and Ceylon: distributed to South America, the West Indies, and Tropical Africa."

Although occasionally met with in most districts of India, in only a few localities is it reported to be fairly abundant. With the view of affording information as to the localities where an effort might be made to develop a trade in the kapok fibre—the floss from the seeds of this plant—the following review of the official correspondence and writings of Indian authors may be given here.

BENGAL. Of Bengal **Roxburgh** says: "On the Coromandel Coast, the Tamils plant the tree about their temples. In Bengal, where the winters are colder, the leaves drop off during the hot season. In February, when destitute of foliage, the blossoms appear, and soon afterwards the leaves: the seed ripens in May." The writer is not aware of having seen the tree in Bengal except as planted along road-sides and in gardens. **Mr. Gamble** does not mention any special locality, but adds that it is

N. W. P. "often planted." **Dr. King** in a list of the plants of the North-West Provinces (printed in the *Gazetteer, Vol. IV., p. LXVIII.*) simply mentions it by name. In his *Forest Flora of North-West and Central India*, **Sir D. Brandis** makes no mention of the tree, and **Dr. Stewart** is also silent as to

PANJAB. its occurrence in the Panjáb; but **Mr. Baden Powell**, in his *Panjáb Products*, mentions it briefly without stating where it is met with.* It would thus appear that as far as these provinces are concerned, while the plant occurs occasionally under cultivation, there is little or no prospect of a trade being done in the fibre from the wild or naturalised plant. Of Coromandel it may be otherwise. **Roxburgh** appears to have found it fairly plentiful. **Sir Walter Elliot** speaks of it as met with in that region, and gives it

BURMA. the Telegu name of *Buruga*. Turning to Burma, **Kurz** remarks that it is "here and there cultivated in Pegu and Tenasserim; a single tree was observed wild in the coast forests of South Andaman." **Mr. Baden Powell**, in a re-cast of **Brandis's** classification of the Burmese Teak forests, mentions **Eriodendron** as occurring on the lower undulating hills along with bamboo, **Xylia, Pterocarpus, Albizzia, Terminalia, Dillenia, Hibiscus,** and **Bombax** (*Indian Forester, VIII., 415*).

MADRAS. In the Madras Presidency generally, the tree would appear to be by no means of unfrequent occurrence. **Dr. Shortt** (*Indian Forester, III., 236*) alludes to it in a list of plants parts of which are eaten in times of famine. He gives it the following names: *Elevam*, TAMIL; *Púr*, TELEGU; and he remarks that it is "found in gardens, the seeds being roasted and

* The writer recently saw one specimen a little below Suni on the banks of the Sutlej.

eaten." **Dr. Moodeen Sheriff** (in his forthcoming work on the *Materia Medica of South India*) gives a detailed account of the plant, distinguishing it from **Bombax malabaricum**; but while he states that "the cotton is always found in the bazars and is much cheaper than the common cotton," he does not mention from what source it is obtained. In the Manual of Trichinopoly the tree is referred to in a list of the "more important fruit and timber trees found in the district." It is said to be the *ilavam* or *ilava* of Tamil, and the remark is made: "The seeds are embedded in silky cotton, which is used for stuffing beds, cushions, &c." In the Nellore Manual **Eriodendron** is given in a "List of the Principal Trees of the District" and receives the Telegu name *Buraga*. In the *Mysore Gazetteer* (Volume I., 58) the tree is alluded to as grown in the Bangalore gardens, but in a List of the trees of Mysore, **Mr. Cameron** gives it the Kanarese name of *Bili burga*. **Dr. George Bidie**, in a Catalogue of the Drugs of the Madras Presidency, refers to the unripe fruits of this plant as being "demulcent and astringent, and used in medicine as well as cookery." He gives the drug the following names—*Khatyan-ka-kalli*, DUK.; *Marati-moggu*, TAM.; and *Buraga-pintha*, TEL. At the Colonial and Indian Exhibition an interesting series of the products of this plant was shown. **Mr. J. W. Cherry**, of the Forest Department, furnished from Salem—

No. 25, KAPOK. MADRAS.

MYSORE.

No. 7749 Fibre from the stem;	No. 7812 Oil seed;
No. 8453 Floss from the seeds;	No. 7515 Gum.
No. 7771 Medicinal fruits;	

Sir George Birdwood, in his *Bombay Products*, mentions the plant as met with in "Khandesh, Travancore, and Coromandel." It has been customary to read of the plant being, as far as India is concerned, most abundant in the Deccan. A recent correspondence would, however, appear to throw doubt on this prevalent opinion. **Mr. McGregor**, Conservator of Forests, Southern Circle, Bombay, in his first letter on the subject, wrote that **Eriodendron anfractuosum** "is said to occur in Kanara, but its occurrence is doubtful." He gave it the names of *Pandhari*, *savar*, MAR.; and *Bili barlu*, KAN. In the same correspondence the Conservator of the Northern Circle, Bombay, was asked for information regarding the tree, and **Mr. A T. Shuttleworth** replied that "**Eriodendron anfractuosum**, though stated in some botanical publications to be a common tree in the forests of the northern circle, is exceedingly rare, and in Khandesh, where it is supposed to grow in large numbers, there is scarcely a tree of the kind to be seen in the forests. Authors of works on the Forest Flora of Western India have evidentally mistaken some other tree—probably **Bombax malabaricum**—for the Kapok or white cotton tree."

BOMBAY.

For 2nd letter see p. 336.

It would thus appear that there is room for doubt as to the existence in Bombay of **Eriodendron** as an abundant tree, and much confusion appears still to prevail in the identification of the Kapok tree; popular writers are apparently unable to recognise it from **Bombax**. The vernacular names now given to the Kapok tree might easily enough be adaptations from the names given to **Bombax**. The Sanskrit word *sálmali* is by some writers given to the one, by others to the other. *Sálmali*-wood is prescribed in the Institutes of Manu as that on which washermen should wash clothes. No writer definitely affirms that **Eriodendron** is wild; nearly all speak of it as cultivated, and it may be the case that India can only hope to take part in the growing kapok trade after some years when the tree has been still further cultivated in some of the regions where it is now successfully grown. It would, however, be undesirable to accept as final the present information; and as in a measure opposed to the opinions expressed by **Mr. McGregor** and **Mr. Shuttleworth**

Salmali wood. Conf. with p. 325.

Conf. with the further communications now received, pp. 335 to 337.

No. 25. KAPOK.

BOMBAY.

it may be as well to complete this brief review by quoting some of the passages in which it is affirmed that **Eriodendron** is a fairly common tree in both the southern and northern divisions of Bombay. **Lisboa** (*Useful Plants of Bombay, p. 195*) says: It is "a very common prickly tree with palmate leaves and dingy white flowers." There can be no mistake as to the plant there meant; it is **Eriodendron** and not **Bombax**. **Dalzell** and **Gibson** also describe the tree in language which cannot be mistaken, and they add: "It grows in Khandesh;" its native name being "*Shameula*." **Dr. Gray**, in his essay on the "Botany of the Bombay Presidency" (*Gazetteer, XXV., 322*), says that "**Eriodendron** is another large tree" (he has just been speaking of **Bombax**) "similarly distributed in this country." "It is known as the white silk-cotton tree." Of **Bombax** he says it "is common in all the forests of the Presidency from Gujarat and Khandesh to Kánara." Turning now to the Bombay Gazetteers **Mr. Talbot**, in the Kánara volume, says that **Eriodendron anfractuosum** is the *Bile burlu* of the Konkan, and *pándhari sávar* of Mar.; he remarks that "the white-cotton, though fairly large, does not grow to the same size as **Bombax malabaricum**. The pods are gathered for their cotton." Of the Panch Mahâls it is stated that "the *Shamla*, **Eriodendron anfractuosnm**," is similar in appearance to **Bombax malabaricum**, the *Shimal* or *Shimar*, "but differs in the flower," those of **Bombax** "a dull crimson and those of **Eriodendron** a dirty white." The writer of the chapter on the Panch Mahál forests thus made no mistake, and **Mr. Talbot's** reputation as a botanist warrants the most complete confidence being placed on his statement that the tree occurs in Kánara. Of the Poona District it is stated: "*Hallian*, **Eriodendron anfractuosum**, though not plentiful, is found in the thicker forests on the western hills. The light and soft wood is used in tanning leather and for making toys. The fine soft silky wool which surrounds the seeds is used for making cushions. It yields a gum called *hattian-ke-gond*, which is valued in bowel complaints." Of the Khandesh District it is stated: "*Katsávar*, **Eriodendron anfractuosum**, sometimes called a **Bombax** and confounded with the *simal*, has a white soft wood of no use, save for making toys or fancy articles. The down round its seeds is used for stuffing pillows. It is not common anywhere in Khandesh."

Its existence in Bombay. Conf. with p. 337.

(These passages from the Gazetteers should be compared with **Mr. McGregor's** and **Mr. Shuttleworth's** letters below, pages 335 to 337.)

The writer can find no other descriptions of the plant (as met with in Bombay), and can only suggest that the question deserves to be still further enquired into, especially in the southern division of Bombay and northern districts of Madras. Applications are likely to be made in the future as to the extent India can supply the fibre, and it is therefore desirable to know definitely whether it can do so at all from an indigenous or naturalised stock. If not, the further question may have to be considered whether it would not be desirable to make an effort to plant out accessible tracts of available forest land with the view of being able in the future to meet the demand for the fibre. It is hoped that the above brief review may stimulate observers in every corner of India to furnish information as to the existence or otherwise of the tree in forests regarding which very little of a definite character is as yet known.

GUM.

Gum.

This gum is of a dark-red colour and almost opaque. It is generally known as *hattian-ke-gond*, and by European writers is said to be one of the forms of the *Katéra* or hog-gums, *e.g.*, the pseudo-gums, or those which are insoluble in water but swell and form a pasty mass. Accordingly **Dr. Cooke**, in his Report on the Gums of India, places it along with the gums from **Cochlospermum, Gossypium, Sterculia urens**, and **Uvaria tomentosa**, but these being pale coloured it is assigned its more

No. 25, KAPOK. FIBRE.

immediate position in the sub-series—the dark coloured pseudo-gums—such as **Moringa pterygosperma, Stereospermum suaveolens, Ailanthus excelsa, Macaranga tomentosa,** and **Bombax malabaricum.** This gum is, however, said to be astringent and to be employed medicinally in bowel complaints. Ainslie, who wrote in Madras at the beginning of the present century, says: "A solution of this gum is given in conjunction with spices in certain stages of bowel complaints. We are told by Rumphius (*Amb, I., p. 194, t. 80*), who speaks of the tree under the name of **Eriophorus javana,** that the inhabitants of the island of Celebes eat the seeds of it. It is the *Capock* of the Malays." Then follows a botanical description, which shows that Ainslie clearly distinguished this plant from **Bombax.** This fact is of considerable importance, as it confirms the suggestion, already thrown out, that the true Indian habitat of the plant may be Southern India. He gives the tree the Sanskrit name of "*Mullie,*" and adds that it is the *panta-paniala* of the *Hort. Mal. (III., p. 59, t. 49, 50 & 51).* It is interesting to note that the name *kapok* (or *capock*) was known a hundred years ago, and that it is a Malayan and not a Dutch name as some writers have stated. Only the other day a great advance was supposed to have been made by the discovery of the plant from which the Dutch fibre *kapok* was obtained. This fibre was well known to Ainslie nearly a century ago, and it is worthy of remark that the word *kapok* bears a close resemblance to the *kárpási* of the Sanskrit writers, and that the most general modern names for the plant *Hattian* and *Kattan* seem to be directly derived from the Arabic *Kattan*; both these classical names are, however, now stated to be synonyms for cotton. (Conf. with the remarks at page 324.) **Sir William O'Shaughnessy** (*Beng. Dispens., 227*) also alludes to the gum as being medicinal.

Tan.—The wood is said to be used in tanning leather.

Fibre.

Bark. Fibre.

An inferior reddish fibre is sometimes prepared from the bark which is used locally for making ropes and paper. This was analysed by **Messrs. Cross, Bevan** and **King,** and their results, published in the recent report on Indian fibres, are as follows:—moisture 12·4 per cent.; ash 95 per cent.; loss by hydrolysis (one hour's boiling in solution 1 per cent. Na_2O) 50·5 per cent; cellulose 33·6 per cent.; loss by mercerising 7·5 per cent.; and by acid purification 6·1 per cent. The ultimate fibres were only 1—2 mm. in length. These figures may be accepted as fully disposing of the bark fibre of this plant from all further consideration. The barking of the trees should, if possible, be prohibited, since the proceeds from the fibre thus obtained would by no means compensate for the injury done to the tree as a source of floss.

Floss or fibre from the seeds.

The *Kapok* or floss from the seeds is, however, according to the present demand, a fibre of great merit. The modern trade in it was created by the Dutch merchants, their supply being drawn from Java. It is used in upholstery, being too short a staple to be spun, and, indeed, too brittle and elastic. But these are the very properties that commend the floss to the upholsterer. In cushions, mattresses, &c., its elasticity and harshness prevent its becoming matted as is the case with *simal* floss, and it is, therefore, considerably superior to that fibre. Indeed, it is probable that the even still shorter staple of **Cochlospermum** would in time command a better price than that of the *simal.* Like *Kapok* it is very elastic, the fibre springing up to its former position the moment the weight is removed from the cushion. With *simal,* on the other hand, a very short time suffices to make a mattress assume permanently a compressed condition, in which it occupies perhaps less than half its original bulk and at the same time becomes knotted. This necessitates the removal of the stuffing to be teaseled or rudely carded.

No. 25, KAPOK. FIBRE.

It will thus be seen that if future extended usage of *Kapok* confirms the properties attributed to it, the demand for the fibre will year by year increase. But while endeavouring to participate in this trade it becomes essentially necessary that an error made by many writers be guarded against, namely, of viewing *Kapok* as a generic trade-name for all the silk-cottons—including that of the *simal*—the floss of **Bombax malabaricum**. When the demand for *Kapok* first started, Indian exporters placed in the market a quantity of very dirty *simal* having a large percentage of dust as well as seed. This was at once condemned and fetched a price that would not even cover the transport charges. India thus fell into an inferior position which it is possible might even have been the case had carefully cleaned *simal* been sent to Europe. A low-priced fibre like that of *simal* or *Kapok* cannot bear the extra freight charges of a large percentage of dust. It becomes essentially necessary that the floss be cleaned, freed of seed, and carefully baled. At the Colonial and Indian Exhibition, a large assortment of *simal* floss was shown, and the writer had the opportunity of conversing with several Dutch and English dealers in *Kapok*. These gentlemen assorted the *simal* samples and pointed to the fact that even among these there were inferior and superior qualities. Some had twice as long a staple as others, while the *Kapok* property of elasticity was possessed by few only. After this had been done **Mr. Cherry's** true *Kapok* floss was shown, when in every case the experts recognised it as *Kapok* and were eager to know the price, amount available annually, and the names of merchants with whom they might open up dealings. Unfortunately these were points regarding which no information could be furnished.

Mistaken ideas regarding Bombax and Eriodendron.

The necessity for care in future efforts may be apparent when it is here stated that nearly every trade journal which has published notices regarding *Kapok* has viewed it as one and the same thing with *simal*. Thus the *Indian Agriculturist* (October 16th, 1886) says that every person in India is familiar with "the value of the 'tree-cotton,' as stuffing for pillows and bedding, and *Kapok*, which is really the Malayan name for it, is the designation by which it is known in the Dutch and Australian markets, &c. &c." The writer of that article was apparently very liberally compiling from a paper which appeared in *Buchanan's Monthly Register* (Melbourne, June 21st, 1886), in which the tree-cotton—**Bombax malabaricum**—is incidentally mentioned along with **Cochlospermum Gossypium** and the *Baobab* tree of Africa as "in their growth and products" possessing "very little difference." Indeed, it seems probable that, as far as the Australian trade in Kapok from India is concerned, the floss of **Bombax malabaricum** is that which is so designated. While that may be so, the necessity for distinguishing the two fibres none the less remains in its full force, and the above reference to the *Indian Agriculturist* has been made in the hope of guarding against any ignorant or mistaken continuance of the error here indicated. A reference was recently made by the Government of India to Her Majesty's Consul at Batavia, Java, asking the name of the plant from which the Kapok fibre was obtained, and "also whether the exports of the tree cotton obtained from the **Bombax** or **Eriodendron** trees are the larger." The reply may be here published, as it is highly instructive:—

"BRITISH CONSULATE,
"BATAVIA;
"*10th November 1887.*

"I have the honour to acknowledge receipt of your letter No. 214—24-1 F. & S. of the 29th September last, and, in reply thereto, I beg to inform you that the scientific name of the tree from which Kapok is chiefly

No. 52. KAPOK FIBRE.

obtained in Java is **Eriodendron anfractuosum.** The exports of Kapok from the Netherlands India have been as follows:—

	Kilos.
1882	302,201
1883	341,136
1884	426,061
1885	600,269"

Thus there can no longer remain any doubt as to the Kapok of Java, and it is instructive to observe how the exports of that fibre have steadily increased, having been in 1885 twice those of 1882. It is worth adding also that **Bombax malabaricum** is a native of Java, and, apparently, a more abundant tree than **Eriodendron anfractuosum.**

A correspondence has recently taken place between the Government of India and the Government of Bombay on the present position of the Indian Kapok trade and the possibility of future development. The opinions of the Conservators of the Northern and Southern Divisions of Bombay expressed in early letters have already been quoted; but, as the correspondence is of considerable interest, the further replies from the Conservators may be here reproduced in full. **Mr. Shuttleworth's** last letter leaves very little room for doubt but that greatly exaggerated opinions have been published as to the prevalence of the tree in the forests of the Northern Division of Bombay.

From A. T. SHUTTLEWORTH, Esq., Conservator of Forests, Northern Circle, to T. D. MACKENZIE, Esq., Chief Secretary to Government of Bombay,—No. 4885, dated 10th December 1887.

With reference to Government memorandum No. 7344, dated 28th October 1887, I have the honour to report that I have never known, and from inquiries made I cannot find, that any distinction is recognised or maintained in the local or export markets in this circle between the tree-cotton, or, as it is sometimes called, silk tree-cotton, obtained from the **Bombax malabaricum,** and that produced by the **Eriodendron anfractuosum.** Tree-cotton of both trees is used locally for the same purposes, *viz.*, for stuffing pillows, quilted cloth such as *rezzais,* jackets, &c., and bedding. Very small quantities of it leave the district in which it may be collected. And the export from Bombay under its commercial designation of "Kapok" or the silk tree-cotton is very trifling, as the following statement, which has been furnished to me very kindly by the Secretary of the Bombay Chamber of Commerce, will show:—

YEARS.	Melbourne.	Havre.	London.	Hamburgh.	Marseilles.	Hongkong.	TOTAL.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
1883	100	...	...	...	...	...	100
1884	276	...	...	...	...	...	276
1885	...	...	12	8	10	...	30
1886	466	7	10	...	...	17	500
1887	...	...	...	...	...	...	*Nil.*

* * * * * *

3. The tree generally known in the Konkan as the silk-cotton tree, is the **Bombax malabaricum,** also called by some botanists **Salmalia mala-**

No. 25, KAPOK. FIBRE.

barica, Bombax heptaphyllum, Gossampinus rubra; it grows to a large size, has a prickly trunk, palmate leaves, flowers bright red or scarlet, to be seen generally in February and March; in the early morning they sometimes contain a limpid sweet fluid which natives drink. The native name of this tree varies according to districts, from *Saur, Sawa, Semal, Sembal, Simal.* It is very sparingly found above the Ghâts to the north of the watershed dividing the Tapti from the Godavery basin, and is not common in Guzerat.

4. The silk-cotton tree of Khandesh and of the northern portion of this circle is the Eriodendron anfractuosum, synonymous with Bombax pentandrum, Gossampinus alba, which grows into a large tree in Khandesh and Guzerat; it also has a prickly trunk, palmate leaves, but flowers dingy white and drooping. Its native name varies territorially from *Shamenla, Shamla, Semal, Shimal, Safed Simal,* or white *Simal.*

5. I am not in a position to say that there is a difference in the qualities of the fibres of the two trees, which can both claim to belong to the order or tribe BOMBACEÆ derived from *Bombax*, the Greek for cotton or silk. It may be, however, that the cotton of one is superior to that of the other; anyhow the material supplied by both, the red and the white silk-cotton tree, so called from the colours of their flowers, is in local request for stuffing pillows and quilted articles, but is not used for other purposes.

From the Conservator of Forests, Southern Circle, to the Under-Secretary to the Government of Bombay, Revenue Department,—No. 4207, dated 6th January 1888.

Conf. with MR. Talbot's statement that Eriodendron occurs n Kanara, p. 332.

In reply to your No. 7344 of 28th October 1887, and subsequent reminder, No. 8744 of the 24th ultimo, regarding the Eriodendron anfractuosum, I have the honour to inform you that the Divisional officers are unable to discover it, and that I have never heard of its occurrence in our forests. It is not mentioned in Brandis's *Forest Flora.*

2. The Bombax malabaricum, which must be very nearly allied to the Eriodendron, is very common in the jungles of Kánara and the adjacent jungles of Dharwar and Belgaum. Its vernacular name is *Sawári*, and I think, after reading the article in the *Indian Agriculturist*, that the pods exported from India probably belong to this species. The writer evidently does not know anything about the trees from personal observation, and the "cotton," with which he is possibly alone acquainted, of trees of the Eriodendon, is probably so similar to that of the Bombax that only an expert could distinguish them. The pillows of the non-commissioned officer who took part in the campaign of 1843 was no doubt stuffed with the common silk-cotton of the Mahratha country.

3. This tree flowers about April and the pods ripen in May. Samples could be sent to Bombay to any merchant desirous of trying it as an article of commerce.

[Conf. with the reference to the *Indian Agriculturist*, page 334.—ED.]

From J. NUGENT, Esq., C.S., Chief Secretary to the Government of Bombay, to the Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT,—No. 5346, dated 8th August 1888.

With reference to Mr. Officiating Under-Secretary Macpherson's letter No. 44—10-2 F. & S., dated 7th March 1888, I am directed to forward herewith, for the information of the Government of India, a copy of a memorandum, No. 2392, dated the 25th ultimo, from the Conservator of Forests, Northern Circle, in which that officer reports the result of the

No. 25, KAPOK.

FIBRE.

further inquiries made by him with respect to the existence of the **Eriodendron anfractuosum** in the forests of the Northern Circle.

Memorandum by the Conservator of Forests, Northern Circle, dated 25th July 1888.

The Conservator of Forests, Northern Circle, has the honour to report that he has caused very searching inquiries to be made in all the divisions of the Northern Circle, with the result that the **Eriodendron anfractuosum** has been found to be *a very rare and uncommon tree throughout the Northern Circle.*

2. In the Thana Collectorate a few solitary trees may be seen. In the Khandesh Collectorate, where it is stated to be "a common tree" by some botanists, it is so sparsely represented that it is estimated not more than two maunds of the floss could be collected annually. In the Nasik, Poona, Satara, and Surat Collectorates respectively not more than twenty trees of the species have been discovered; while in the Pánch Mahals, Ahmednagar, and Sholapur Collectorates the tree does not exist.

3. Where **Dr. Gray** obtained the information, published in his *Botany of the Bombay Presidency*, that the **Eriodendron anfractuosum** is "common in all the forests of the presidency from Guzerat and Khandesh to Kanara," and how **Dr. Lisboa**, *vide* his *Useful Plants of Bombay* (page 195), arrived at the conclusion that the **Eriodendron anfractuosum** is "a very common prickly tree," the Conservator is at a loss to know; but he feels sure that personal travel and research by these gentlemen does not support the statements.

4. **Dr. Gibson** remarks, very correctly, in the *Bombay Flora*, that the **Eriodendron anfractuosum** is to be found in Khandesh, but he does not report it to be a common tree in that district; and even if it were so in his time it is no longer so now.

5. **Dr. E. Balfour**, in his *Timber Trees*, records that the **Eriodendron anfractuosum** is "not common on the Bombay side save in some parts of Khandesh." It is improbable that **Dr. Balfour** ever travelled over Khandesh or had any personal knowledge of the presence of the tree in numerous or sparse representation in that district.

6. The **Bombax malabaricum** is, it may be mentioned, a very common tree in the forests and districts of the Northern Circle, and it is not improbable that this tree may have been mistaken for the **Eriodendron anfractuosum** when not in flower; otherwise it is difficult to conceive how the latter can be described by any authority as a very common tree in the Northern Circle.

Oil of Eriodendrum.

OIL.

The seeds are said to yield a bright red or dark-brown clear oil. **Dr. Cooke**, in his *Report on the Oils and Oil-seeds of India* (p. 43), mentions a sample as in the possession of the Indian Museum (obtained from Chingleput), and adds that the oil was first made known at the Madras Exhibition of 1857. The peculiar properties of this oil are unknown, but from the fact that the seeds are often eaten it may be inferred that the oil is edible.

Food.

FOOD. Seeds.

FODDER. Oil-cake.

The seeds are said to be eaten and the young or unripe fruits are also stated to be used in cookery. The seed-cake is sometimes given as FODDER. **Dr. Warden** has kindly furnished the following note on this subject showing the comparative composition of Kapok to Cotton-seeds:—

§ "The seeds of the Kapok tree have been made into cakes, and the comparative value of these cakes and ordinary cotton-seed cake for cattle-

No. 25, KAPOK.

feeding purposes has formed the subject of an enquiry by **Mr. G. Reinders.** The following analytical results were obtained:—

	Kapok cake.	Cotton cake.
Water	13·28	12·6
Nitrogenous matter; albuminous compounds	26·34	20·62
Fat	5·82	6·36.
Non-nitrogenous extraction	19·92	35·42
Woody fibre	28·12	20·36
Ash	6.52	5.64

"The ash of the Kapok-tree seed contains 28·5 per cent. of phosphoric acid and 24·6 per cent. of potash; it ought, therefore, to be of value as a manure."

MEDICINE.

Medicine of Eriodendron.

Gum: Floss.

It has already been stated that the gum obtained from this plant is used medicinally in bowel complaints, having attributed to it a useful astringent property. **Dr. Moodeen Sheriff** recommends the floss or cotton for medicinal use, as it is cheaper than common cotton. It is also cooler and more elastic and on that account might be recommended for cushions and pillows used in hospitals and also for stuffing to bandages and other such surgical dressings. The dry young fruits have also been alluded to as used medicinally, and **Dr. Moodeen Sheriff** explains that the best mode of procuring them is to have them collected from the ground underneath the trees. A large number of things are often sold as the fruits of this tree, some even poisonous, such as the unripe fruits of *Datura*. By collecting them from the ground below the trees this is prevented, but at the same time immature or rather unfertilized fruits would be so collected, since if fertilized they would not fall to the ground. These fruits are similar in their properties though inferior to those of **Bombax.** "The dry young fruits of **Eriodendron anfractuosum** are sometimes sold in the bazars under the same name," *viz.*, *Maráti-Moggu*, "and used for the purpose of adulteration and substitution of those of **Bombax malabaricum.** Although the similarity between the fruits of both plants is very great, yet the difference between their stalks, which are almost always attached to them, is so distinct that they can be very easily distinguished from each other. The fruits of **Eriodendron** are always round, not angled, and somewhat larger and of a darker colour; the fruit-stalk of the **Eriodendron,** however, is round, about the thickness of a pin, and two or three times longer than the fruit." These unripe fruits are regarded as demulcent and astringent. The exact original use of the expression *Maráti-Moggu* is not quite clear—*Moggu* means buds. The roots are also used medicinally, being one of the forms of *Músla* or *Músli-sémul* (described under **Bombax malabaricum,** Dictionary, Vol. I., B. 653). **Dr. Dymock** explains that in the Concan the young roots of **Eriodendron** are preferred to those of **Bombax.** "They are dried in the shade, powdered and mixed with the juice of the fresh bark and sugar. This tree is called *Pándhra Saur* in Marathi and *Dolo Shamlo* in Guzerathi" (*Mat. Med. West India, 2nd Ed., 106*). The leaves and also the seeds have medicinal virtues attributed to them, but they do not seem of sufficient merit to deserve separate description.

Flower-buds.

Roots.

Leaves. Seeds.

Special Opinions.—§ "A handful of the tender leaves of this plant is ground into a paste and is administered to a patient newly attacked with gonorrhœa. One dose at 6 A.M. is given daily for three or four days, and a little butter-milk is taken with it" (*Surgeon W. F. Thomas, Madras Army, Mangalore*). "The gum is also used in the incontinence of urine of children" (*Surgeon-Major J. J. L. Rutton, M.D., M C., Salem*). "The

cotton of the fruit is soft; it is used for mattress generally" (*V. Ummegudien, Mettapollian, Madras*). "The root of the young plant is used in the form of decoction in cases of chronic dysentery and diarrhœa, also in cases of ascites and anasarca when it acts as a diuretic" (*Civil Surgeon J. H. Thornton, B.A., M.B., Monghyr*). No. 25. KAPOK.

Structure of the Wood.—Soft, very light; 30lb per cubic foot. According to some writers this is the *Salmali* of Sanskrit writers. It is used for toys and other such purposes, and is sometimes hollowed out into canoes. TIMBER.

GEORGE WATT,

Reporter on Economic Products.

SIMLA,

December 30th, 1888.

INDEX.

A

PAGE

Abacá, name in Luzon for Manilla hemp 2
——— mode of extraction 2
——— manufactures from — 4
Abroma augusta 175, 233, 266, 269
Abutilon 266
Acacia arabica 84
——— bark 83
——— catechu 83, 85
——— leucophlœa 85
——— pycnantha 102
——— Suma 83
——— Sundra 83, 84
Adalsa, *Hind.* and *Bomb.*; Adhatoda Vasica 67
Adarsa, *Hind.* and *Bomb.*; Adhatoda Vasica 67
Adasara, *Tel.*; Adhatoda Vasica 67
Adda, *Tel.*; Bauhinia Vahlii 183
Adhatoda, *Tam*; Adhatoda Vasica 67
Adhatoda Vasica . . . . . 67—81
——— Habitat of — 67, 86
——— Economic properties and uses of — 68, 78
——— Dye extracted from leaves of — . . . 68, 71, 75, 78, 79
——— Medicinal virtues of — 68, 71, 72, 74, 75, 76, 77, 78, 80, 81
——— Charcoal made of — used for Gunpowder . 75, 76, 77, 78, 79, 80, 81
——— Note by J. E. T. Aitchison, in *Kuram Valley Flora*, on — 70
——— used to kill insects 70, 71, 72, 75
——— Advantages of — to Forestry 71
——— leaves chewed with "Pán" as a remedy for colds and coughs 71
——— Cultivation of — 72, 78, 79
——— used in the treatment of cattle disease . . . 75, 79
——— used for lining wells 78, 79, 80
——— used as a charm 78, 79
——— used as fodder 79
——— used for ripening fruit 80
——— imparts a flavour to sugar 81
——— used for roofing 77, 79, 80
——— used as a blood-purifier 77
Adusa, *Guj.*; Adhatoda Vasica 67
Agaládára, *Ceylon*; Adhatoda Vasica 67
Agave americana, the American Aloe 175, 291
——— vivipara, the Bastard Aloe 175
Agri-Horticultural Society, India 48, 272, 317
Ahauna, *Santal*; Calotropis gigantea 186
Ailanthus excelsa 333
Ainslie, Dr. 68, 159, 161, 222
Aitchison, Dr. J. E. T. 70, 150, 153
Ák, *Vern.*; Calotropis gigantea 69
Ak or árk, *Hind.*; Calotropis gigantea 186
Akado, *Guj.*; Calotropis gigantea 186
Akanda, *Beng.*; Calotropis gigantea 186
Akra rúi, *Bomb.*; Calotropis gigantea 186

PAGE

Al, *Gus.;* Dioscorea sativa 164
Ál, *Vern.;* Morinda citrifolia 57
Alesi, *Nepal;* Adhatoda Vasica 67
Aloe 175
Amarantus paniculatus 12
Ambádí or ambárí, *W. Ind.;* Hibiscus cannabinus 246
Ambári, Hemp . . . . . 266, 267—269, 270
American cotton 54
Ámla, *Vern.;* Phyllanthus Emblica 86
Amuale, *Vern.;* Myrobalans 57
Amorphophallus campanulatus 149, 150, 152
Ananas sativa 167
Andropogon muricatus, *Khas-khas* 167
Anogeissus latifolia 85, 91
Anona squamosa 268
Anthrax 79
Antichorus depressus, *Linn.; Syn.* for Corchorus Antichorus, *Rœusch.* . . 217
Aonta, *Vern.;* Phyllanthus Emblica 86
Apricot 11
Arare, *Vern.;* Myrobalans 57
Arátorá, *Duk.;* Adhatoda Vasica 67
Arbuthnot & Co. 30
Ardhi supári, *Mar.;* Caryota urens 188
Arenga saccharifera 189
Aretean, *Vern.;* Myrobalans 57
Are tíge, *Tel.;* Dioscorea oppositifolia 162
Arjha san, *N.-W. P.;* Crotalaria juncea 246
Ark, al-arka, *Sans.;* Calotropis gigantea 186
Arrack 190
Arus, *Sans.;* Adhatoda Vasica 67
Arusa, *Hind.* and *Bomb.;* Adhatoda Vasica 67
Asans, or ausans, prayer carpets used by Hindus 25, 29
Asclepias tenacissima 320
Asna, or asaina, *Vern.;* Terminalia tomentosa 87
Atár, *Bihar;* Dioscorea sativa 164
Atibala, *Sans.;* Sida rhombifolia 279
Atibala chettu, *Tel.;* Sida rhomboidea 278
Atkinson, Mr. E. T. 151, 165, 183, 223, 272, 316
Ato sang, *Santali;* Dioscorea glabra 161, 164
Aupoz, name in the Philippines for inner fibre 4
Ausa, *Assam;* Crotalaria juncea 246
Avatenga tige, *Tel.;* Dioscorea oppositifolia 162

B

Babar grass, a substitute for Esparto 169
Babúl 85
Babuna, *Pb.;* Corchorus Antichorus 217
Baccurea sapida 93
Badal-sunn, *Beng.;* Crotalaria juncea 246
Baden Powell, Mr. H. 150, 159, 160, 293, 330
Bahika, *Ass.;* Adhatoda Vasica 76
Bahuk, *Ass.;* Adhatoda Vasica 76
Bahúphallí, *Pb.;* Corchorus Antichorus 217
Bakardharra, *Kum.;* Osyris arborea 59
Bakarja, *Kum.;* Osyris arborea 59
Bakas, *Beng.;* Adhatoda Vasica 67
Balfour, Dr. J. 3, 337
Ball, Mr. 65
Bandala, name in the Philippines for the outer fibre 4

PAGE

Ban-dhenras, *Vern.*; fibre of Hibiscus ficulneus 272
Ban-pát, *Beng.*; Corchorus fascicularis 221
———, *Beng.*; Corchorus olitorius 222
———, *Sind.*; Corchorus olitorius 222
Ban-phal, *N.-W. P.* and *Pb.*; Corchorus olitorius 222
Ban-rhea, *Assam*; Villebrunea integrifolia 172, 283, 312, 315
Báphallí, *Pb.*; Corchorus acutangulus 216
Baphulí, *Hind.*; Corchorus Antichorus 217
Baphúlli, *Pb.*; Corchorus Antichorus 217
Bara flawar, *Ass.*; Caryota urens 188
Barbadoes Yam 157
Barley 10, 11, 12
——— time of sowing and reaping — 10
——— Brewing of beer from — 12
Basang, *C. P.*; Adhatoda Vasica 76
Bashangarus, *Kum.*; Adhatoda Vasica 67
Bashi, *Pb.*; Adhatoda Vasica 67
Básmatí, *Kulu*; Rice 12
——— *Kum.*; Rice 13
——— selling price of — 13
Basoti, *Pb.*; Adhatoda Vasica 67
Bassia latifolia 93
Bast fibres 265
Basung, *Uriya*; Adhatoda Vasica 67
Basuti, *Pb.*; Adhatoda Vasica 67
Batatas 147
Bathu, *Simla*; Amarantus paniculatus 12
Bauhinia Vahlii, the Málú fibre . . . . . 169, 183—186, 268
——— uses of the fibre 183
Bé, a Karen name for edible Coix 141
Beddome, Col. H. 315
Bekkar, *Pb.*; Adhatoda Vasica 67
Be-kwa, a Karen name for cylindrical Coix 141
Bé-ma, a Karen name for the female Coix 141
Bengal 202, 252, 262
——— Chamber of Commerce 50
Bengo nári, *Santali*; Dioscorea globosa 162
Beral, *Orissa*; Jute 217
Berli, berli-mád, berli-mhár, bhirli-mahad, bherlá-máda, *Mar.*; Caryota urens 188
Betu-sag, *Vern.*; Chenopodium album 13
Bhágá-sunn, *Beng.*; Crotalaria juncea 246
Bhang, *Vern.*; Hemp 57
Bhauphalí, *Bomb.*; Corchorus fascicularis 221
Bherawá, *Mar.*; Caryota urens 188
Bhora álu, *Hind.* and *Beng.*; Dioscorea nummularia 162
Bhungí, *Beng.*; Corchorus olitorius 222
Bhunjí pát, *Beng.*; Corchorus olitorius 222
Bhus, *Chanda*; Coix Kœnigii 138
Bhut, *Vern.*; Soy bean, Glycine Soja 14
Bhyni, baini, beina, bagni, *Kan.*; Caryota urens 189
Bidie, Dr. G. 217, 223, 225, 331
Bíj-elosha, *Sind.*; Calotropis gigantea 186
Bili burga, bili-barlu, *Kan.*; Eriodendron anfractuosum 329
Bil-nálita, *Beng.*; Corchorus fascicularis 221
Bíl-nálitá, *Vern.*; Corchorus Antichorus 222
Birdwood, Sir G. 101, 325, 331
Bir sangi, *Santali*; Dioscorea aculeata 156
Bixa Orellana 55
——— A red and yellow dye obtained from — 55

PAGE

Bixa Orellana, Dye from roots and leaves of — 55, 56
———— Permanent colour produced from — 55, 56
———— Mode of extracting dye from — 55
———— Price of dye from— 55
Blechynden, Mr. 1, 3
Bœhmeria nivea . . . . . 258, 283—312
———— tenacissima 283, 312
Bombax Gossypium, yellow-cotton tree 329
——— malabaricum . . . . . 174, 326—327
Bombay 192, 197, 205, 253, 254, 256
Bombay-hemp 266
Bonda, a young cocoa-nut 198
Bophallí, *Pb.;* Corchorus Antichorus 217
Borassus flabelliformis 170
Borla, *Nepal;* Bauhinia Vahlii 183
Bosotan, *Lahoul;* Buck-wheat 11
Botat (Bazaar name), *Bomb., Goa;* Dioscorea aculeata 156
Brandis, Sir D. 175
Brapú drawo, *Chenab;* Fagopyrum esculentum 11
Breed of Sheep in Bengal 41
Bres, *Chenab;* Fagopyrum esculentum 11
Bres, *Ravi;* Fagopyrum esculentum 11
Broussonetia papyrifera (Paper mulberry) 175
Brus pháphrá, *Sutlej;* Fagopyrum esculentum 11
Buchanan-Hamilton, Dr. F. 56, 203, 225, 253, 270, 285
Buck-wheat 10, 11, 12
———— Time of sowing and reaping 10
——— as food 11
Búi, *Pb.;* Crotalaria Burhia 246
Burma 202
Buruga, *Tel.;* the Kapok tree 330
Búta, bhata, *Pb.;* Crotalaria Burhia 246
Buxton, Ronald & Co. 47

C

Cadjans 209
Cæsalpinia Bonducella 72, 121
———— Coriaria 107
Caloce or Caluse 285
Calotropis gigantea used as manure 69, 170
————————, Madar fibre . 170, 174, 179, 186, 188, 321, 326, 327, 329
Calotropis procera 170, 186, 327
Calycopteris floribunda 73
Calysaccion 55
Campbell, Dr. 285, 314
————, Revd. A. . . . 145, 151, 162, 163, 170, 187, 226, 327—329
Canada, Grains suitable for — 8-14
Cannabis sativa (Hemp) 176, 247, 266
Capsi, *Bomb.;* Debregeasia velutina 319
Caryota sobolifera 190
Caryota urens, the Kittul fibre . . . . . 170, 188—190
————————, Particulars about tapping— 190
Cassia auriculata 86
Casuarina equisetifolia 93
Cedrela Toona, used as manure 69, 72
Ceriops Roxburghii 92
Chaina, *Bomb.;* Dioscorea globosa 162
Chakmas, square rugs 25, 26, 27, 29, 30
Chambolli, *Duk.;* Bauhinia Vahlii 183

PAGE

Chambúra, *Mar.*; Bauhinia Vahlii 183
Charbor, *Mar.*; Bauhinia Vahlii 183
Chata-veli, *Mar.*; Dioscorea pentaphylla 163
Chau, *Simla*; Amarantus paniculatus 12
Chawg, *Vern.*; Beer brewed from rice and barley 12
Chayena, *Bomb.*; Dioscorea tomentosa 165
Chedu paddu dumpa, *Tel.*; Dioscorea bulbifera 159
Cheep 61
—— Price of —. 61
—— Uses of —. 61
Chehur, *Beng.*; Bauhinia Vahlii 183
Chéna, *Vern.*; Panicum miliaceum 11
Chenopodium album 13
Chenyel, *Bomb.*; Dioscorea tomentosa 165
Cherry, Mr. J. W. 331, 334
Chhota-pindálu, *Dec.*; Dioscorea aculeata 156
Chickrassia tabularis 86
Chin, *Kolhapur*; Dioscorea alata 157
Chín, *Jhelam*; Fagopyrum esculentum 11
——, *Vern.*; Panicum miliaceum 11
China, *Bomb.*; Dioscorea sativa 164
——, *Vern.*; Panicum miliaceum 11
China or (Chéna?); Panicum miliaceum 11
China-grass . . . . . 283—290, 306—312
Chitsee, a form of Coix seed 121, 141
Chittí, *Vern.*; Marsdenia tenacissima 320
Chola, *Kulu*; Cicer arietinum 12
Chopri álu, *Bomb.*; Dioscorea globosa 162
Chub, Round, & Co. 204, 206
Chun-pat, *Beng.*; Crotalaria juncea 246
Chúpri álu, *Hind.*, *Beng.*; Dioscorea globosa 162
Church, Prof. 135, 144
Cicer arietinum, Gram 12
Cicer soongaricum 13, 14
Cissampelos Pareira 216
Clarke, Mr. C. B. 169, 218
——, Mr. S. E. J. 46
Climatic conditions of Leh, Kailang, Simla, Murree, Multan, and Sialkot . 9
Cloth. Manufacture of — from jute 243, 244
Cobaltiferous Matt 61
Cochin Native State 191, 213
Cochlospermum Gossypium 174, 329
Cocoa-nut Palm 193
——. Facts regarding the cultivation of — . . . . . 194—5
——. Cultivated forms of — . . . . . 195—6
——. Soils suited for the cultivation of — 196
——. Peculiarities of Indian cultivation . . . . . 197—202
—— in Bombay 197
—— in Madras 198
—— in Mysore 200
—— in Nicobar Islands 201
—— in Burma 202
—— in Bengal 202
—— in Upper India 202
—— in Ceylon 202
—— in Sind 205
—— products . . . . . 209—212
—— insect pests 198
—— cotton 208
Cocos nucifera (Cocoa-nut Palm) . . . . . 171, 191—214

PAGE

Cogswell, Mr. W. H. 167, 233, 276, 281
Coir 171
—— fibre. Properties of — . . . . . 202—209
———— Trade in — 206, 211
———— Uses of 208
—— ropes 212
Coix . . . . . 113—146
——, Cylindrical form of — 115, 119, 120
——, Globular form of — 115, 119, 120
—— aquatica 138 140
—— gigantea 137, 140
—— Kœnigii 114, 138
—— Lachryma 114, 117, 119, 138
—— Tabular statement . . . . . 122-3, 125-6, 130—32
Colocasia antiquorum 13, 164
Common Yam, Dioscorea sativa 164
Conda panna, *Tam.*; Caryota urens 189
Conocephalus niveus 319
Conway-Gordon, Col. 238
Cooke, Dr. T. 71, 332
Copra or Copperah 193, 209, 210
Coptis Teeta 224
Corchorus, *Linn.* . . . . . 216—244
———— acutangulus, *Lam.* 216
———— antichorus, *Rœusch.* 216, 217
———— capsularis, *Linn.* 167, 217, 221
————————. Botanical Diagnosis 218
————————. Habitat of — 218, 221
————————. Fibre of — 221
————————. Medicinal virtues of — 221
————————. Oil of — 221
———— fascicularis, *Lam.* 221-2
———— fuscus, *Roxb.*; *Syn.* for Corchorus acutangulus, *Lam* . . 216
———— humilis, *Munro*; *Syn.* for Corchorus Antichorus, *Rœusch.* . 217
———— olitorius, *Linn.* . . . . . 167, 222—226
————————. Botanical diagnosis of — 222
————————. Habitat of — . . . . . 223—225
————————. Fibre of — 225
————————. Medicinal virtues of — 225
———————— used as food 225
————————. Domestic uses of — 226
———— tridens, *Linn.* 216, 226
————————. Botanical Diagnosis of — 226
————————. Habitat of — 226
————————. Fibre of — 226
———— trilocularis, *Linn.* 216, 226
————————. Botanical Diagnosis of — 226
————————. Habitat of— 226
————————. Fibre of — 226
————————. Medicinal virtues of — 226, 227
Cordery, Mr. J. G. 305
Cordia Myxa 77
Corypha umbraculifera 189
Cotton 53, 54
———. History of — 323-4
Country or Common Yam, Dioscorea purpurea 163
Cross, Bevan, and King, Messrs. Method of hydrolysis 185
———————— Analysis of Bauhinia Vahlii . . 169, 184
———————— of Hemp 176
———————— of Flax 177

PAGE

Cross, Bevan, and King, Messrs. Analysis of Jute 168, 234
——————. ——— of Sunn-hemp . .171, 259, 260
——————. ——— of Hibiscus cannabinus . . 268
——————. ——— of Sida 281
——————. ——— of Rhea 289
——————. ——— of Maoutia Puya . . . 314
——————. ——— of Marsdenia 321
——————. ——— of Calotropis 328
——————. ———of Eriodendron . . . 333
Cross-breeding for the improvement of Bengal sheep . . 38, 39, 40, 41
Crotalaria . . . . . 246—264
——— Burhia 246
——— juncea (Sunn-hemp) 171, 225, 246, 266, 269
——— tenuifolia 246
Croton tiglium 198
Cucumbers 13
Cultivation. System of — 11
Cuscuta 80
Cutch 83, 84

D

Dáb, *Beng.;* Cocos nucifera 193
Dalli, horse-cloth or housing 29
Dalzell and Gibson 156, 332
Dampa, *Tel.;* Dioscorea aculeata 156
Dandalu, *Sans.;* Dioscorea alata 157
Danga gurgur, *Beng.;* Coix gigantea 137
Daphne papyracea (Nepal paper-fibre) 176
Darachte-nargíl, darachte-bándinj, *Pers.;* Cocos nucifera . . . 193
Darán, *Vern.;* Fagopyrum emarginatum 11
Daula, *Vern.;* Phyllanthus emblica 86
Death and Ellwood, Machines for fibre extraction 3, 272
Debregeasia velutina 319
Decaisne, M. 286
DeCandolle, M. A. 151, 152, 157, 194, 219, 224, 225, 248, 250, 286
Deccani-hemp . . . . . 266—67
Désaváli-pendalam, *Tel.;* Dioscorea purpurea 163
Despatches to or from Her Majesty's Secretary of State . . . 100, 114
Dey, Dr. K. L. 222, 225
Dharúr, *Pb.;* Dioscorea deltoides 160
Dháurá, *Vern.;* Anogeissus latifolia 85
Dhává, *Vern.;* Anogeissus latifolia 85
Dhola, *Guz.;* Dioscorea sativa 164
Dioscorea, Yam . . . . . 147—166
——— aculeata 156
——————— used as food 157
——— alata 157
——— anguina 158
——— atropurpurea 158
——— Batatas 159
——— bulbifera 159
——— crispata, *Roxb.* 160
——— dæmona, *Roxb.* 160
——— deltoides, *Wall.* 159, 160
——— fasciculata, *Roxb.* 161
——— glabra, *Roxb.* 161
——— globosa, *Roxb.* 162
——— nummularia, *Lamarck* 162

PAGE

Dioscorea oppositifolia, *Linn.* 162
——— pentaphylla, *Willd.* 163
——— pulchella, *Hohenhacker; Syn.* for Dioscorea bulbifera, *Linn.* . 159
———, *Roxb.; Syn.* for Dioscorea bulbifera, *Linn.* . 159, 163
——— purpurea, *Roxb.* 163
——— quinata, *Wall.* 164
——— rubella, *Roxb.* 164
——— sagitata, *Royle* 164
——— sativa, *Linn.* 164
——— tamnifolia, *Salisb. Syn.* for Dioscorea bulbifera, *Linn.* . . 159
——— tomentosa, *Kœnig.* 165
——— tomentosa, *Hohenhacker; Syn.* for Dioscorea tomentosa, *Kœnig.* 165
——— triphylla, *Linn* 165
——— versicolor, *Wall.* 165
Diospyros Embryopteris 91
Directors of Land Records and Agriculture—
Assam 75
Bengal . . . . . 31, 34—36, 80, 231, 236
Bombay 70
Burma 74, 118, 120, 121, 124, 127, 129, 136, 143
Central Provinces 76
North-West Provinces 23
Punjab 77
Divi-divi . . . . . 83, 90, 100—104, 107
Dola álu, *Chutia Nagpore;* Dioscorea versicolor 165
Dolichos biflorus ♀ 12
Drunnú, *Sind.*, Crotalaria Burhia 246
Drury 222
Dudha álu, *Chutia Nagpore*, Dioscorea versicolor 165
Duffus, Mr. J. 237
Dula, *Pb.;* Hibiscus ficulneus 272
Durma mats 169
Duthie, Mr. J. F. . . . . 116, 172, 175, 217, 218, 223, 300—304
Duthie and Fuller, Messrs. . . . . 117, 251—255, 270
Dutt, Dr. U. C. 68, 151, 220, 222
Dye—Note on 53, 57
Dyer, Mr. W. T. T. 113, 145
Dymock, Dr. W. 145, 153, 157, 164, 222, 226

E

Eddu tóka dumpa, *Tel.;* Dioscorea glabra 161
Eleusine corocana 12
——— Spirits and Beer made from — 12
——— Bread made from flour of — 12
Elevam, elavum, *Tam.;* Eriodendron anfractuosum 329
Elliott, Sir W. 151, 159, 216, 246, 330
Em, *Ladak;* Chenopodium album 13
Emblic myrobalan 86
Erim-pana, *Tam.;* Caryota urens 189
Eriodendron. Fibre or floss from the seeds of — 333
———. Medicinal products from— 338
———. Oil and oilcake from the seeds of — 337
——— anfractuosum 174, 324, 326, 329
Erra-bondala, *Tel.;* Cocos nucifera 193
Erukha, *Tam.;* Calotropis gigantea 186
Erukku, erica, *Mal.;* Calotropis gigantea 186
Erund, *Bomb.;* Jatropha Curcas 73
Ervum lens 12

PAGE

Esparto grass 169
Evans, Messrs. 85, 87, 98, 101

F

Fagopyrum esculentum 11, 12
——— tataricum 11
Falconer, Dr. 313
Favier, M. 287, 289, 291
Fibre, Jute 216, 244
Ficus bengalensis 73
Fiji Yam; Dioscorea pentaphylla 163
Finucane, Mr. 31, 34, 36, 80, 231, 236
Firminger, Mr. 156, 164
Flax 177, 321
Flosses and Silk Cotton of India 323, 339
Forest Department –
Conservator, Northern Division, Bombay 70, 335, 337
Do. Southern Division, Bombay 71, 336
Do. N.-W. Provinces 95
Do. Assam 76, 299
Fruit in Upper Lahoul and Spiti 11

G

Gajir, *Hind.;* Dioscorea versicolor 165
Gamble, Mr. J. S. 223, 316, 330
Ganjira, *Hind.;* Dioscorea versicolor 165
Ganja, *Vern.;* hemp 57
Gan-sag, *Pb. hills;* Chenopodium album 13
Gar tushiara, *Vern.;* Villebrunea frutescens 315
Genasu, *Kan.;* Dioscorea aculeata 156
———. Cultivation of— 157
Genthi, *Hind.;* Dioscorea versicolor 165
———, *Kumaon;* Dioscorea versicolor 165
Genti, *Chutia Nagpur;* Dioscorea versicolor 165
Genti gajir, *Kumaon;* Dioscorea versicolor 165
Ghagari, *Mar.;* Crotalaria Burhia 246
Ghagharu tág, *Mar.;* Crotalaria juncea 246
Ghanjin, *Kumaon;* Dioscorea versicolor 165
Ghantár-avamu, *Sans.;* Crotalaria juncea 246
Ghellagadi, *Chanda;* Coix Kœnigii 138
Ghi-nálitá, *Vern.;* Corchorus capsularis 222
Ghi-nalitá-pat, *Beng.;* Corchorus capsularis 217
Ghugharo, *Gus.;* Crotalaria Burhia 246
Ghuiya, *Vern.;* Colocasia antiquorum 13
Gibson, Dr. 218, 270
Girardinia heterophylla (Nilgiri Nettle) 177, 260, 319
——— zeylanica 177, 317
Githi, *Bijnor, N.-W. P.;* Dioscorea versicolor 165
Glenrock Co. Method of fibre extraction 3, 288, 319
Glycine Soja, Soy bean 12, 14, 128, 146
Gmelina arborea 76
Goa Potato, Dioscorea aculeata 156
Goburri-koya, *Tel.;* Cocos nucifera 193
Godri, *Bomb.;* Dioscorea sativa 164
Gollam, Mr. W. 295
Gorádu, *Khandesh;* Dioscorea alata 157
Gorádu, *Mar., Dec.;* Dioscorea sativa 164
Goragú, gorregu, *Tel.;* Caryota urens 189

PAGE

Goran álu, *Beng.;* Dioscorea rubella 164
Gorkan, *Mar., Dec.;* Dioscorea sativa 164
Gossypium arboreum 54
——— herbaceum 54, 216
Gourds 13
Gram, Cicer arietinum 12, 14
Grass Mats 168
Gray, Dr. W. 73, 274, 332, 337
Green manures 73
Greig, Mr. 306
Gudimi donda pendalam, *Tel.;* Dioscorea alata 157
Gugi or ghooghi, hooded cloak for horsemen 25, 29, 30
Guinea Yam, Dioscorea aculeata 156
Gujju-narekadam, *Tel.;* Cocos nucifera 193
Gún, *Kumaon;* Dioscorea deltoides, *Wall* 160
Gúna pendálam, *Tel.;* Dioscorea globosa 162
Gúngrú, *Pb.;* Dioscorea bulbifera 139
Gúngrú, *Pb.;* Dioscorea deltoides 160
Gunny. Manufacture of — from jute 243
———. Export and Home consumption of — 242
Gupte, Mr. A. B. 172, 274
Guraniya álu, *Beng.;* Dioscorea rubella 164
Gurgur, *Beng.;* Coix Kœnigii 138
Gutij, *Vern.;* Myrobalans 57
Gyon-ni, *Burm.;* Red wheat 119
Gyon wa, *Burm.;* Yellow wheat 119

H

Haba, *Bomb.;* Marsdenia tenacissima 320
Hadu-karanda, *Bomb.;* Dioscorea bulbifera 159
Hall, Mr. W. T. Correspondence on Coix . . . . . 118—143
Hana, *Sing.;* Crotalaria juncea 246
Hanuman, *Orissa;* Jute 217
Hannay, Major . . . . . 279—280, 285, 299, 317
Hardwickia binata 169, 268
Harrana, *Shahjehanpur, N.-W.P.;* Corchorus capsularis 217
Hasskarl, M. 288
Haworth, Mr. 280
Heerda, *Vern.;* Terminalia chebula 54
Heggenasu, *Kan.;* Dioscorea sativa 164
Heli, *Vern.;* Dioscorea alata 158
Helianthus tuberosus, Jerusalem Artichoke 13
Helicteres Isora 169
Helmia bulbifera, *Kunth.; Syn.* for Dioscorea bulbifera 159
——— dæmona, *Kunth.; Syn.* for Dioscorea dæmona, *Roxb.* 160
——— tomentosa, *Kunth.; Syn.* for Dioscorea tomentosa, *Kœnig.* 165
Hemp 228, 247
———. Price of Andaman — 1,
———. Strength or breaking point of — . . . . .
———. Cleaning or extraction 2, 3
——— Indian 57
———. Origin of the word — . . . . . 248—49
Hendley, Sur.-Maj. T. H. 24
Hyde Colonel 306
Hibiscus . . . . . 266—273
——— cannabinus . . . . . 172, 246, 267—272
——— fibre . . . . . 268—270
———. Cultivation 270
———. Area 272

PAGE

Hibiscus ficulneus 272, 273
——— tiliaceus 172, 273
Hides . . . . . 105—106
Hill Palm 188
Hirankhori, *Bomb.;* Corchorus fascicularis 221
Hiri-tala, *Sing.;* Dioscorea oppositifolia 162
Hlyamban, *Magh.;* Caryota urens 189
Hnan-pyaung, *Burm.;* Sorghum vulgare 118
Hollins, Mr. 328
Hooker, Sir J. D. 142, 218, 281
Horse-chesnut 11
Hove, Dr. . . . . 55—58, 250
Huddart, Messrs. 317
Hummel's, Professor, Analysis of Indian Tanning Materials . . 90—94
Hunsraj, *Kum.;* Rice 13
——— Selling price of — 13
Hunter, Sir W. W. 201, 206

I

Ima, *Vern.;* Dioscorea alata 158
Indian Corn, Maize 13, 134
Indigo 57
Inula dysenterica 138
Ipomæa Batatas, sweet potato 13, 149
Irr, *Pb. hills;* Chenopodium album 13
Isband, *Pb.;* Corchorus acutangulus 216
Isbund (seeds) *Sind;* Corchorus trilocularis 226, 227
Ischœmum angustifolium 169

J

Jackson, Mr. 204, 206
Jadhirdah, *Arab.;* Cocos nucifera 193
Jai-nimaz, Mussulman prayer carpets 25
Jaisee, *Burm.;* a form of corn seed 121, 141
Jallur, *Hind.;* Bauhinia Vahlii 183
Janab, *Dec.;* Crotalaria juncea 246
Janapa, jenappa, janumú, *Tam. & Tel.;* Crotalaria juncea . . . 246
Jangli, *Beng.;* Corchorus fascicularis 221
Jatorpha curcas 73
Jatu, *Kulu;* Rice 12
Jenkins, Major 285
Jepal, *Bomb.;* Jatropha Curcas 73
Jerusalem Artichoke, Helianthus tuberosus 13
Jetee fibre 320
Jew's Mallow, *Eng.;* Corchorus olitorius 222
Jeypore. Woollen Manufactures of — 25, 28
Jhada, *Guj.;* Calotropis gigantea 186
Jháda, *Guj.;* Cocos nucifera 193
Jhuri, *Nep.;* Osyris arborea 59
Jillédu, jilleru, *Tel.;* Calotropis gigantea 186
Jirúgú, *Tel.;* Caryota urens, *Tel.* 189
Joba, *Vern.;* Hibiscus rosa-sinensis 266
Job's Tears (Coix) 113, 139
Jom, *Santali;* Bauhinia Vahlii 183
Jowar, Sorghum vulgare 116
Jute . . . . . 167, 227—244
——. Derivation of the word . . . . . 219—221, 227
——. Corchorus . . . . . 227—244
——. History of the — industry . . . . . 227—229

PAGE

Jute. Cultivation of — and preparation of the fibre 229, 230
——. Area under cultivation of — 229, 230, 231
——. Soil 231
——. Climate 231
——. Preparation of soil 231
——. Seed 231
——. Harvest time 231
——. Cropper acre 232
——. Separation of — fibre by retting 232
——. Extraction of — fibre by means of machinery 232
——. Properties of — fibre 233
——. Strength and industrial properties of — fibre 234
——. Price of cultivation of — 235, 236
——. Commercial varieties of — 237, 238
——. Foreign Trade in — and — manufactures 238
——. Internal and Coasting Trade in — 238
——. Exportation and Home consumption of raw — 239
——. Manufactures of — and their exportation from India . . 240, 241
——. Foreign Trade in manufactures of — 241
——. Local or Home consumption of — . . . . . 241—243
——. Cassification of the — manufactures 243
——. Indigenous manufactures of — 243
——. European manufactures of — 244
——. Manufacture of whisky from — 244

K

Kaawi Yam, Dioscorea aculeata 156
Káhunway, *Burm.;* Dioscorea cristata 160
Kachálú, *Kulu;* Ipomæa Batatas 13
Kadpi, *Central Provinces;* Coix Kœnigii 138
Kadráti, *Gond.;* Calotropis gigantea 186
Ka-dwœ-oo, *Burm.;* Dioscorea fasciculata 161
Kagshi, *Vern.;* Villebrunea frutescens 315
Kahata-kondol, *Sing.;* Dioscorea alata 157
Kahu-kukulalu, *Sing.;* Dioscorea aculeata 156
Kaing, *Burm.;* Elephant grass 118
Kálá báthu, *Pb. hills;* Chenopodium album 13
Kalambir, *Mala.;* Cocos nucifera 193
Kalapa, *Mala., Java;* Cocos nucifera 193
Kálasáka, *Sans.;* Corchorus capsularis 217
Kála trúmba, *Jhelam;* Fagopyrum esculentum 11
Kaleik, variety of Coix 140
Kalinsee, a form of Coix seed 121
Kalithi, *Burm.;* Coix 141
Kalon, *Kulu;* Pisum arvense 12
Kalung, *Tam.;* Dioscorea alata 157
Kamal, a coarse blanket 24-25
Kam álu, *Bomb.;* Dioscorea alata 157
Kamela, dye, Mallotus philippinensis 56, 57
Kanab, *Pers.;* Cannabis sativa 248
Kandá 149
Kangar, *Poona;* Dioscorea fasciculata 161
Kangni, *Burm.;* Setaria italica 116
Kangra, *Orissa;* Jute 217
Kankhura or konkura, *Beng.;* Urtica tenacissima 285
Káns, *Pb.;* Dioscorea deltoides 160
Kánta, *Bomb., Goa;* Dioscorea aculeata 156
Kanta, *Orissa;* Jute 217
Kanta-álu, *Bomb.;* Dioscorea pentaphylla 163

PAGE

Kanta-álu, *Hind.;* Dioscorea pentaphylla 163
Kanta álú, *N.-W. P.;* Dioscorea pentaphylla 163
Kántékàngi, *Bomb., Goa.;* Dioscorea aculeata 156
Kantu-kelangu, *Tam.;* Dioscorea aculeata 156
Kapasiya, *N.-W. P.;* Hibiscus ficulneus 272
Kapok . . . . . 174, 175, 324, 329—339
Kaphitié, *Vern.;* Villebrunea integrifolia 315
Karanda, *Poona;* Dioscorea bulbifera 159
Karanj, *Tanjore;* Pongamia glabra 73
Karen Potato, Dioscorea fasciculata 161
Karinda, *Bomb.;* Dioscorea bulbifera 159
Karma, *Chenab;* Fagopyrum esculentum 11
Karpas, karpasi 324
Kárn pendalam, *Tel.;* Dioscorea nummularia 162
Kaspat, *Pb.;* Dioscorea bulbifera 159
Kaspat, *Pb.;* Dioscorea deltoides 160
Kaspat, *Pb.;* Fagopyrum esculentum 11
Kata-kelenga, *Tel.;* Dioscorea aculeata 156
Kátek, *Burm.;* Dioscorea glabra 161
Kath, *Nepal;* Adhatoda Vasica 67
Kathálu, *Assam;* Dioscorea bulbifera 159
Kathar, *Behar;* Dioscorea sativa 164
Káthú *Vern.?* Fagopyrum esculentum 12
Káthú, *Bias:* Fagopyrum esculentum 11
Káthú tráo, *Spiti;* Fagopyrum esculentum 11
Katú, *Chenab;* Fagopyrum esculentum 11
Katú, *Ravi;* Fagopyrum esculentum 11
Katu-katsjil, *Malay;* Dioscorea bulbifera 159
Katu-wala, *Sing.;* Dioscorea pentaphylla 163
Kaun-phal, *Bomb.;* Dioscorea sativa 164
Kaunti, *Sans.;* Corchorus trilocularis 226
Kauri, *Chutia Nagpore;* Dioscorea versicolor 165
Kauriála, *Pb.;* Crotalaria Burhia 246
Kawan Yam, Dioscorea pentaphylla 163
Kaya pendalam, *Tel.;* Dioscorea crispata 160
Kerr, Mr. H. C. 216, 217, 220, 224, 239, 250, 279
Kesai, *Berar;* Coix gigantea 137
Khaki Cotton 54
Khám-álu, *Hind. & Beng.;* Dioscorea alata 157
Khamharna, Dioscorea sativa 164
Kharif crops 8, 9
Khark, *Pers.;* Calotropis gigantea 186
Kharsan, *Pb.;* Crotalaria Burhia 246
Khaun phal, *Bomb.;* Dioscorea globosa 162
Khas Khas 167
Khelí, *Pb.;* Dioscorea deltoides 160
Khip, khippi, khep, khif, *Pb.;* Crotalaria Burhia 246
Kimbo, *Burm.;* Caryota urens 189
King, Dr. G. 118, 175, 274, 293, 330
King, Dr. W. 61, 63
Kinghenna, *Kan.;* Cocos nucifera 193
Kinnab, *Arab.;* Cannabis sativa 248
Kirma, *Vern.;* Villebrunea frutescens 315
Kirma-gilaram gadi, *Chanda;* Coix Kœnigii 138
Kirri-kondol, *Sing.;* Dioscorea alata 157
Kissury, *Vern.;* Mallotus philippinensis 55
Kithí, *Pb.;* Dioscorea bulbifera 159
Kithí, *Pb.;* Dioscorea deltoides 160
Kittul fibre 170, 171, 188
Knecht, Dr. E. 89
Knísa, *Pb.;* Dioscorea bulbifera 159

PAGE

Kníss, *Pb.;* Dioscorea deltoides 160
Kobbari chettu, kobri chullú, *Tel.;* Cocos nucifera 193
Kodra, *Vern.;* Eleusine corocana 12
Kon, *Poona;* Dioscorea alata 157
Koru-karinda, *Dec.;* Dioscorea bulbifera 159
Koshtá, *Vern.;* Jute 217
Koshta, *Beng.;* Corchorus olitorius 222
———, *Hind.;* Corchorus olitorius 222
Kostra, *Orissa;* Jute 217
Kowria, *Orissa,* Jute 217
Krish, *Pb.;* Dioscorea deltoides 160
Kríss, *Pb.;* Dioscorea bulbifera 159
——, *Pb.;* Dioscorea deltoides 160
Kshauma, a linen garment 248
Kúkúr-álu, *Beng.;* Dioscorea anguina 158
Kult, *Kulu;* Dolichos biflorus 12
Kúmbi, *Hind., Pb.;* Cochlospermum Gossypium 329
Kummara baddu, *Tel.;* Dioscorea aculeata 156
Kúndal-panai, *Tam.;* Caryota urens 189
Kúrand, *Pb.;* Corchorus Antichorus 217
Kurú chuntz, *Bomb.;* Corchorus triloculáris 226
Kurú kanda, *Chanda;* Dioscorea bulbifera 159
Kurz, Mr. S. 114, 117, 118, 160, 161, 223, 316
Kyaip, *Burm.,* a form of Coix 114
Kyeikthi, collective name for Coix 140, 141
Kyeikphun, white globular Coix 140
Kyeikshe, cylindrical Coix 140
Kyeit, *Burm.,* a form of Coix 119, 141
Kydia calycina 268
Kyinki, kienki, yenki, *Vern.;* Maoutia 312
Kyway, *Burm.;* Dioscorea dæmona 160
Kyway-nway, *Burm.;* Dioscorea dæmona 160
Kyway-pin, *Burm.;* Dioscorea dæmona 160
————, *Burm.;* Dioscorea tomentosa 165

L

Laccadive Islands 191, 199, 205, 207, 211, 213
Lal-bariala or berela, *Beng.;* Sida rhombifolia 279
Lal-gurania-álu, *Hind., Beng.;* Dioscorea purpurea 163
Lalita pát, *Beng.;* Corchorus olitorius 222
Lama, *Kol.;* Bauhinia Vahlii 183
Lami, *Macassar;* Dioscorea alata 158
Langalin, *Sans.;* Cocos nucifera 193
Lasurian 77
Latar, *Bihar;* Dioscorea sativa 164
Lathia, *Pb.;* Crotalaria Burhia 246
Lawsonia alba. Dye produced from — 56
Lentils 12
Lethbridge, Dr. 33
Linen 177
Lingúrella, *Sing.;* Dioscorea alata 157
Linschoten's, John Huyghen, account of —
Bixa dye 57
Yams 147
Cocoa-nut 213
Linum usitatissimum (Flax) 177, 248
Liotard, Mr L. 3
Lipic, lipiáh, *Vern.;* Villebrunea integrifolia 315
Liquorice 77, 78

PAGE
Lisboa, Mr. J. C. 72, 156, 157, 165. 225, 249, 271
Lois, a fine woollen manufacture 24, 25, 26
Lugri, beer made from Kodra, Eleusine corocana 12
Lunuk, *Pb. hills;* Chenopodium album 13
Lúpis, delicate fibre from the petiole in Luzon 4
Lutu, *Vern.;* Dioscorea alata 158

M

Maar, már, mahad, *Bomb.;* Cocos nucifera 193
Macaranga tomentosa 333
Máda, *Vern.;* Calotropis gigantea 69
Máda, mahad, *Mar.;* Cocos nucifera 193
Madar fibre 170
Madár, *Hind.;* Calotropis gigantea 327
Madder 186
Madhválu, *Sans.;* Dioscorea aculeata 156
Madras 192, 198, 252
——— jute-fibre of Hibiscus cannabinus 269
Magina muniya, *Kumaon;* Dioscorea pentaphylla 163
Magiya, *Kumaon;* Dioscorea quinata 164
Mah, *Kulu;* Phaseolus radiatus 12
Mahábalá, *Sans.;* Sida rhomboidea 278
Mahalan, *C. P.;* Bauhinia Vahlii 183
Mahua, *Vern.;* Bassia latifolia 94
Mahúl, *Uriya;* Bauhinia Vahlii 183
Maize 12, 13
Malabar coast 191, 199, 205, 207, 211, 213
Malachra capitata . . . . . 172, 227, 266, 269, 273—277
——— rotundifolia 274
Maláká-kaya-pendalam, *Tel.;* Dioscorea bulbifera 159
Maldives 199, 205, 207, 213
Maljan, *Hind.;* Bauhinia Vahlii 183
Mallet, Mr. 61
Mallotus philippinensis 55, 92
Málú fibre of Bauhinia Vahlii 183
——. Dye extracted from — 184
——. Processes of bleeching and dyeing . . . . . 184—5
Malvaceous fibres . . . . . 265—282
Manálu, *Beng.;* Dioscorea aculeata 156
Man-álu, *Hind.;* Dioscorea aculeata 156
Mándá, *Mar.;* Dioscorea triphylla 165
Manihot 149
Manilla Hemp 3
———. Character and uses of, 4; Experimental cultivation, 4; References to official correspondence . . . . . 5—6
Mangifera indica, the wild Mango 94
Maoutia Puya, the Poi Rhea of Assam 172, 260, 283, 289, 312, 315
Mann, Mr. G. 299
Manure. Adhatoda Vasica used as— . . 68, 69, 71, 74, 75, 76, 78, 79, 80, 81
Marantia dichotoma 1-8
Márapasapolí, *Bomb.;* Dioscorea oppositifolia 162
Mari, *Hind.;* Caryota urens 188
Mari-ká-jhár, *Deh.;* Caryota urens 188
Már-páspoli, *Bomb.;* Dioscorea oppositifolia 162
Marsdenia tenacissima 123, 233, 258, 283, 320, 322
Marshall & Co. 289
Martin, Miller & Co. 102
Mason, Revd. 116, 128, 143, 158, 161

PAGE

Masur, *Kulu;* Ervumlens 12
Matar, *Kulu;* Pisumarvense 12
Matí álu, *Assam;* Dioscorea bulbifera 159
Mauve de mif, *French;* Corchorus olitorius 224
Maya, *Burm.;* Adhatoda Vasica 67
Mayo-beng, *Burm.;* Calotropis gigantea 186
McCabe, Mr., Deputy Commissioner, Naga Hills 142, 144
McGregor, Mr. 331, 336
McMurray, Mr. 164, 280
McReddie, Dr. 297, 298
Meini, *Pb.;* Crotalaria Burhia 240
Melia Azadirachta 69, 72
Melokych, *Arabic;* Corchorus olitorius 225
Melons 13
Mes-aki, *Vern.;* Villebrunea frutescens 315
Mestapát, *Beng.;* Hibiscus cannabinus 246
Mhár mardi, mari, *Tel.;* Caryota urens 189
Millet, Panicum miliaceum 11, 12, 13
——— (*Lu*); Paspalum scrobiculatum. List of varieties . . 127, 133—137
——— (*Pyaung*); Sorghum vulgare. List of varieties . . 127, 133—137
——— (*Sat*); Setaria italica. List of varieties . . . 127, 133—137
Mimosa bark 102
Mimusops Elengi 93
Minbo, minbaw, *Burm.;* Caryota urens 189
Mitchell, Mr. R. 154
Moodeen Sheriff 220, 331, 338
Moneton, Mr. 326
Montgomery, Mr. . . . . 305—311
Morinda 91
——— citrifolia 57
——— tinctoria 57
Moringa pterygosperma 333
Morocarpus microcephalus 315
Mouálu, *Beng.;* Dioscorea aculeata 156
Múdhírí, *Sind.;* Corchorus Antichorus 217
Müeller, Baron F. Von. 157, 163
Mukerji, Dr. T. N. 169, 170, 173, 175, 179
Mulilava, mulilavu, *Vern.;* Bombax malabaricum 326
Mullu pendalam, *Tel.;* Dioscorea pentaphylla 163
Muniya, *Kumaon;* Dioscorea quinata 164
Munj Grass 179
Murkula, *Vern.;* fibre of Marsdenia 321
Murray, Dr. J. 217, 226
Muruvádúl, *Sing.;* Marsdenia tenacissima 320
Musa textilis . . . . . 1—6, 261, 267, 291
——— paradisiaca 4, 5, 268
Muspratt, M. 288, 289
Myet-yá, *Burm.;* Polytoca heteroclita . . . . . .
Myouk-kya, *Burm.;* Dioscorea crispata 160
Myouk-mway, *Burm.;* Dioscorea glabra 161
Myouk-uí, *Burm.;* Dioscorea atropurpurea 158
Myouk-phal, *Bomb.;* Dioscorea globosa 162
Myrobalans 57
———, *Vern.;* Terminalia . . . . . 87—95
Mysore 192, 200, 249, 252

N

Nádika, *Sans.;* Corchorus olitorius 222
Nálitá, *Vern.;* Corchorus olitorius 222

PAGE

Nálitá, *Orissa;* Jute 217
Nankeen Cotton 54
Nára tega, *Tel.;* Dioscorea glabra 161
Narchá, *Beng.;* Corchorus capsularis 217
Nárel, náriel, náriyal, náriyal-ka-pér, *Hind.;* Cocos nucifera . . . 193
Nárel-ka-jhár, *Duk.;* Cocos nucifera 193
Narich sag, *Chittagong;* Corchorus olitorius 222
Nari kadam, *Tel.;* Cocos nucifera 193
Nárikel, nárakel, *Beng.;* Cocos nucifera 193
Naril, naural, náral-cha-jhádá, *Bomb.;* Cocos nucifera 193
Náriyéla, nariera, *Guj.;* Cocos nucifera 193
Nárula, náralmád; nárali-cha-jháda, *Mar.;* Cocos nucifera . . . 193
Naskarkáni, *Orissa;* Jute 217
Neem, *Vern.;* Melia Azadirachta 69
———. Properties of the — 72
Nella-bendi, *Tam.;* Hibiscus ficulneus 272
Nepal paper 176
Nepora, *Sing.;* Caryota urens 189
Nettle-fibres 267
Nicobar Islands 192, 193, 199, 201, 207, 213
Nilgerri nettle 177
Niluvu-pendalum, *Tel.;* Dioscorea alata 157
North-West Provinces 252, 254, 262
Note on Dioscorea 166
Numdah, a native manufacture from wool 24
———. Seat of — manufacture 25
Nur, nyor, *Malay.;* Cocos nucifera 193
Nureni-kelangu, *Malay.;* Dioscorea pentaphylla 163
Nutia, *Mymensingh;* Corchorus olitorius 222
Nyctanthes arbor-tristis 57
Nymphœa 77

O

Oilseeds 12
Oi moa, *Canton;* Corchorus capsularis 224
On, ong, ung, ung-bin, onsi, onti, ondi, *Burm.;* Cocos nucifera . . 193
Opium 57
Oreocknide, Villebrunea sylvatica 315, 319
Orgal, *Vern.;* Fagopyrum emarginatum 11
Orrah, Mr. . . . . 36—45
Oryza sativa, Rice 12
O'Shaughnessy, Sir W. 224, 225
Oshmor, *Arab.;* Calotropis gigantea 186
Osyris arborea 59
———. Leaves of — used as a substitute for Tea 59

P

Pahúr, *Gond.;* Bauhinia Vahlii 183
Paik shan, paik piven, *Burm.;* Crotalaria juncea 246
Palmer & Co. 102
Pandi mukku dumpa, *Tel.;* Dioscorea pentaphylla 163
Panicum miliaceum 11, 128
——— paspalum 133
——— miliare 118
Panú-kondol, *Sing.;* Dioscorea bulbifera 159
Parinta, *Tel.;* Corchorus olitorius 222
Parwatti, *Pb.;* Dioscorea deltoides 160

PAGE

Paspalum scrobiculatum 127
Pát, *Vern.*; Jute 217
—, *Beng.*; Corchorus olitorius 222
Patni-álu, *Assam*; Dioscorea bulbifera 159
Patsan, *Beng. & N.-W. P.*; Hibiscus cannabinus 246, 267
Patta, *Sans.*; Corchorus olitorius 222
Paul, Dr. B. H. . . . . 88—89, 90
Paur, *Gond.*; Bauhinia Vahlii 183
Pavonia 266
——— zeylanica 179
Pawetta, *Ceylon*; Adhatoda Vasica 67
Pea-fibres 267
Peas 10
Pedumpa, *Tel*; Dioscorea dæmona 160
Peel, Jacob & Co. 47, 48
Pekkar, *Pb.*; Adhatoda Vasica 67
Pendalam, *Nellore*; Dioscorea alata 157
Peppe, Mr. 170
Pératti-kíraí, *Tam.*; Corchorus olitorius 222
Perinta-kúra, *Tel.*; Corchorus olitorius 216, 222
Perinvullie kélunghu, *Malay*; Dioscorea alata 157
Petroleum in Alwar . . . . . 63—65
———. Examination of — by Mr. Oldham 63
———. Examination of — by E. J. Jones 64
Phaphra, *Ravi*; Fagopyrum esculentum 11
Phar, *Bihar*; Dioscorea sativa 164
Phaseolus radiatus 12
Phlogacanthus thyrsiflorus 76
Phormium tenax 291
Pho-sáo, *Burm.*; Dioscorea pentaphylla 163
Phulsan, *N.-W. P.*; Crotalaria juncea 246
Phusar-putta, *Vern.*; Villebrunea frutescens 315
Phyllanthus emblica 86, 91
Picrorhiza kurroa 224
Pindálu, *Sans.*; Dioscorea globosa 162
Pine-apple fibre 167
Piska, *Santali*; Dioscorea bulbifera 159
——, *Santali*; Dioscorea oppositifolia 162
Pisum arvense 12
Poi or pogi, Cocoa-nut sprout 198
Poi dhaula, *Vern.*; Villebrunea frutescens 315
Poi rhea 283, 312
Pola, *Pb.*; Crotalaria Burhia 246
Pol-gass, pol-gahá, pol-nawasi, *Sing.*; Cocos nucifera 193
Pollinia eriopoda 169
Polytoca heteroclita 114, 118
——— Wallichiana 118
Pongamia glabra 73
———. Oil of — kills insects 73
Popli, *Belgaum*; Osyris arborea 59
Poppy 12
Potatos 13, 149
Prain, Dr. D. 117, 153, 218
Prickly-stemmed Yam, Dioscorea aculeata 156
Púa, puya, *Vern.*; Maoutia 312
Pudie-kelengu, *Malay*; Dioscorea aculeata 156
Piya bansa, *Pb.*; Adhatoda Vasica 77
Puli dumpa, *Tel.*; Dioscorea dæmona 160
Pulimanji, *Vern.*; Hibiscus cannabinus 271
Pulivanji, *Mal.*; Crotalaria juncea 246
Pulses 12, 13

PAGE

Pumpkins 13
Punaku cheddy, *Tam.*; Corchorus olitorius 222
Purple Yam, Dioscorea purpurea 163
Pwá-sá-o, *Burm.*; Dioscorea pentaphylla 163
Pyaung, maize-like Coix 140
Pyaung-legauk, *Burm.*; Red millet 118

R

Rabi crops 8, 9, 13
Rája-jíra (seeds), Corchorus trilocularis 226
Rajmahal-hemp 283
Ramie, rhea 283
Rami-tsjima, *Mal.*; Corchorus capsularis 224
Ran-bhendi, *Bomb.*; Malachra capitata 172, 272
Ranee bhendee, *Vern.*; fibre of Malachra 275
Ratálu, *Bihar*; Dioscorea sativa 164
———, *Guj.*; Dioscorea alata 157
———, *Guj.*; Dioscorea sativa 164
———, *Hind.*; Dioscorea sativa 164
———, *Pb.*; Dioscorea sativa 164
Ratar, *Bihar*; Dioscorea sativa 164
Rebsch, Mr. B. A. 96
Red and a Yellow Dye, Bombay, Note on — 53
Red bahuk, Phlogacanthus thyrsiflorus 76
Red Dye from leaves of Lawsonia alba 56
Reh efflorescence 328
Reinhold, Bros. 288
Reru, *Vern.*; Acacia leucophlœa 85
Rhea and Allied Rhea fibres 283, 322
Rhea 173
——. Uses of — 289
——. Cultivation of — 291
——. Patents 283
——. Two forms of —, tropical and temperate 286
——. Chemistry of the two forms of — 288
Ribbentrop, Mr. B. 100
Rice 10, 12, 13
——. Imported 11
——. Brewing of Beer from — 12
Robinson, Mr. 207
Robottom, Mr. A. 189
Rohan, *Vern.*; Soymida febrifuga, a Cutch substitute 86
Rope, Manufacture of — 243
Roselle-hemp 266
Routledge, Mr. R. 183
Roxburgh, 140, 149, 157, 158, 162, 216, 220, 234, 250, 257, 258, 269, 271, 272, 278, 280, 285
Royle, Dr. J. F. 59, 138, 177, 206, 209, 210, 226, 249, 250, 253, 255, 263, 270, 276, 312, 316
Rubia sikkimensis 92
Rudraksha pendalam, *Tel.*; Dioscorea crispata 160
Rukto-gurániya álu, *Hind., Beng.*; Dioscorea purpurea 163
Rung, *Kol.*; Bauhinia Vahlii 183
Rungbong, *Lepcha*; Caryota urens 188
Rus, *Oudh*; Adhatoda Vasica 67
——. Uses of —. 68
Rusa 80

S

PAGE

Saccharum Sara (Munj grass) 179
Sacred Threads, materials of which made 249
Safed kanphal, *Bomb.;* Dioscorea globosa 162
Safed kikar, *Vern.;* Acacia leucophlœa 85
Safed-semal, safed khatyán, *Vern.;* Eriodendron anfractuosum . . . 329
Sago Palm 188
Sain-in, *Chinese;* Dioscorea Batatas 159
Sajji 78
Sakharam Arjun, ... 222
Sakyeik, edible coix 140
Sál, *Vern.;* Shorea robusta . . . . . 87, 94—100
Salmali wood 325
Salopa, *Uriya;* Caryota urens 188
Salsette-hemp, Sunn-hemp of Bombay 270
San, sani, sanai, *Hind.;* Crotalaria juncea 246
Sanabu, shanabina, *Kan.;* Crotalaria juncea 246
San-byaung, white millet 118
Sansevieria 269
San-tág, *Bomb.;* Crotalaria juncea 246
Sappan wood 57
Saratta, *Vern.;* Tribulus terrestris 73
Sariári, *Vern.;* Amarantus paniculatus 12
Sat, *Burm.;* Panicum miliare 118
Sathui, *Beng.;* Dioscorea fasciculata 161
Secretaries to Government Residents, Superintendents—
To Chief Commissioner, Burma 73, 114
To the Panjáb Government 76
To the Bombay Government 336
Superintendent, Port Blair 5
Resident, Nepal 61
Political Agent, Bikánir 26
Board of Revenue, Madras 74
Sedge, Mr. 168
Semul, sémal, símul, simur, simlo, shimul, *Vern.;* Bombax malabaricum . 326, 332, 334
Sen, Mr. A. C. 81
——, Mr. R. S. 219
Sesbania 260
Setaria italica, a species of millet 116, 127, 128
Shajratun-nárjíl, shajratul-jouze-hindi, *Arab.;* Cocos nucifera . . . 193
Shale, cocoa-nut with newly-formed kernel 198
Shanapam, *Tam.* and *Tel.;* Crotalaria juncea 246
Shankar jata, *Guj.;* Caryota urens 189
Sheep. Improvements in the breed of — . . . . . 40—43
Sheep-farming recommended in Berar 35
Shem, *Vern.;* Soymida febrifuga 86
Shendorwel, *Bomb.;* Dioscorea pentaphylla 163
Shesh, *Hebr.;* Flax 248
Shíolí, *Uriya;* Bauhinia Vahlii 183
Shitalpati mats 178
Shiwajatá, *Guj.;* Caryota urens 189
Shorea obtusa 95
——— robusta 87
——— siamensis 95
——— Tumbuggaia 95
——— Talura 95
Short, Dr. 194, 199, 330
Shundapana, *Mal.;* Caryota urens 189
Shuttleworth, Mr. 331, 332, 335

PAGE

Shwet-barjala, *Beng.;* Sida rhomboidea 278
Sida . . . . . 266, 268, 277—282
—— carpinifolia 174
—— microphylla 279
—— obovata 278
—— retusa 278
—— rhombifolia 173, 277, 279, 282
—— rhomboidea 278
—— scabrida 278
Sihár, *C. P.;* Bauhinia Vahlii 183
Silk-cottons . . . . . 170, 174, 323—339
Simmonds, Mr. 196
Simong, *Lepcha;* Caryota urens 188
Sing giká, *Sans.;* Corchorus olitorius 222
Singin janascha, *Hind.;* Corchorus olitorius 222
Sirru-vullie-kelangu, *Tam.;* Dioscorea aculeata 156
Sís, sissái, *Pb.;* Crotalaria Burhia 246
Sorghum vulgare, the greater millet 116, 117, 118
————, white and red grains 119
Soy bean, Glycine Soja 12, 14
Soymida febrifuga 86
Spicer, Mr. R. W. 103
Spons' Encycl. 213, 259, 263, 268, 269, 321
Sterculia urens 332
———— villosa, the Udal fibre 169, 268
Stewart, Col. R. A. 99
———— Captatn J. L. Tanning . . . 105—111, 160, 217, 223, 267, 279
Stocks, Dr. 205
Strachey and Winterbottom 159, 160
Subba dumpa, *Tel.;* Dioscorea tomentosa 165
Suita, *Assam;* Crotalaria juncea 246
Sujjado, *Sind.;* Hibiscus cannabinus 267
Sukadas, *Kulu;* Rice 12
Sumach 90, 106, 107
Sungang, *Lepcha;* Bauhinia Vahlii 183
Sunn-Hemp . . . . . 171—2, 248—264, 321
————, Indian Hemp, Bombay or Salsette Hemp 246
————. Methods of separating the fibre . . . . . 254.
————. Properties and strength of the fibre 257
————. Chemical and microscopic peculiarities of — . . . 260
————. Trade in — 261
————. Uses of— 262
Sur, spirit made from kodra, Eleusine corocana 12
Súsní álu, *Beng.;* Dioscorea fasciculata 161
Suthni, *Bihar;* Dioscorea fasciculata 161
Sweet potato, Ipomæa Batatas 13
Sweet potato 148, 149
Symplocos racemosa 92

T

Taguna, *Kumaon;* Dioscorea pentaphylla 163
Tagur, *Kumaon;* Dioscorea sagitata 164
Tair, *Kumaon;* Dioscorea sagitata 164
Takbret, *Vern.;* Villebrunea frutescens 315
Takuli, *Kumaon;* Dioscorea pentaphylla 163
Talbot, Mr. W. A. 218, 223, 332
Talipot Palm 189
Tambili, *Sing.;* Cocos nucifera 193
Tandassir, *Kan.;* Corchorus trilocularis 226

PAGE

Tangzad, *Lahoul;* Barley 11
Tanning Materials . . . . . 83—111
Tar, *Pb.;* Dioscorea bulbifera 159
——, *Pb.;* Dioscorea deltoides 160
Tarar, *Pb.;* Dioscorea deltoides 151, 160
——— pattr, *Pb.;* Dioscorea deltoides 160
Tardí, *Pb.;* Dioscorea bulbifera 159
——, *Pb.;* Dioscorea deltoides 160
Tarur, *Kumaon;* Dioscorea sagitata 164
———, *N. W. Plains;* Dioscorea sagitata 164
Tarwar, *Vern.;* Cassia auriculata 86
Ta-tway-u, *Burm.;* Dioscorea crispata 160
————, *Burm.;* Dioscorea fasciculata 161
Taur, *Pb.;* Bauhinia Vahlii 183
Taylor, Mr. 321
Tea 59
Teeshœ, *Angami Naga;* Adhatoda Vasica . . . . . 67.
Tegálu, *Tel.;* Dioscorea oppositifolia 162
Tenga, taynga, tengay, tenna-maram, tennan-chedi, *Tam.;* Cocos nucifera 193
Ten kaya, tenkaya-chettu, *Tel.;* Cocos nucifera 193
Terminalia Arjuna 88
———— belerica 88
———— chebula 54, 56, 57, 87, 88, 106
———— tomentosa 87, 88
Tharri, *Pb.;* Dioscorea deltoides 160
Then-pinna, *Kan.;* Cocos nucifera 193
Thompson, Captain W. 317
Thresher & Glennie 327
Tibet, trade in wool . . . . . 31, 32, 34, 46—51
Tilia europœa 265
Tili nálitá, *Vern.;* Corchorus acutangulus 222
Títa, *Orissa;* Jute 217
Tita bahuk, *Ass.;* Adhatoda Vasica 76
Títápát, *Beng.;* Corchorus acutangulus 216
Tobacco 12
Toddy, from Caryota urens 190
Tomentum (Cocoa-nut cotton) 202
Toon, *Vern.;* Cedrela Toona 69, 72
Tora bujja, *Pb.;* Adhatoda Vasica 67
Tráo rjao, *Ladak;* Fagopyrum esculentum 11
Travancore State 192
Treloar, Mr. 202, 203, 208
Trema amboinensis 319
Trebulus terrestris 73
———— used to kill crabs in rice-fields 73
Triticum sativum 119, 127
Tsábri, *Sutlej;* Fagopyrum esculentum 11
Ts-iagri-nuren, *Mal.;* Dioscorea triphylla 165

U

Ubi, Yam 157, 158
Ubium silvestre, *Rumph.;* *Syn.* for Dioscorea dæmona, *Roxb.* 160
Udal fibre 169
Ugoúgal, *Sutlej;* Fagopyrum esculentum 11
Ukshi, *Goa;* Calycopteris floribunda 73
Ulasi, *Mar.;* Dioscorea pentaphylla 163
Ulsi, *Bomb.;* Dioscorea pentaphylla 163
Unah 77

99C

PAGE

Upper India 202
Urena 233, 266
Urtica frutescens 315
—— tenacissima 283
Ushar, *Arab.*; Calotropis gigantea 186
Utali-panna, *Tam.*; Caryota urens 189
Uvaria tomentosa 332
Uvi, Yam 157
Uyala, *Sing.*; Dioscorea tomentosa 165

V

Vakkavanji, *Mal.*; Crotalaria juncea 246
Valonia cups 93
Varala, *Mar.*; Cocos nucifera 193
Varival, *Mar.*; Coix Kœnigii 138
Vasaka, *Sans.*; Adhatoda Vasica 67
Villebrunea frutescens 315
—— integrifolia 174, 283, 315
—— sylvatica 319
Viola odorata 77

W

Wad, *Goa*; Ficus bengalensis 73
Walnut 11
Wana-palla, *Ceylon*; Adhatoda Vasica 67
Warden 337
Warth, Dr. H. 99
Watson, Dr. F. 288, 294, 295, 298, 300, 314
Watson & Co. 212
Weddell, Mr. 288
Wheat 10, 11, 12, 13
——, Time of sowing and reaping 10
——. Triticum sativum, List of varieties . . . . . 127, 133—135
Whisky, Preparation of — from jute 244
White, Yam 157
Wight, Mr. R. 158, 163, 259, 269
—— Bahuk, Adhatoda Vasica 76
Wilson, Mr. F. 231
——, Mr. 184
Wood, Captain 83, 87, 95
Woodfordia floribunda 91
Wool. Production and Trade in India . . . . . 15—52
——. Total Indian production 15
——. Total Indian consumption 15
——. In Bengal 31
——. Prices of — in the N.-W. P. 24
——. —— England 52
——. Frontier trade, imports 16, 31, 32
——, exports 17
——. Manufactures of — by Natives 16
——. —— Europeans 16
——. Foreign trade, imports 17, 19
——. ——, exports 18
—— of Tibet 46
——. Colonial 44
Woondy, *Vern.*; Calysaccion 55
Wuckoo-nar, Jubbulpore Hemp or Travancore Flax 246

PAGE

Y

Yacca gloriosa 179
Yak tails. Trade in — 32
Yam. Dioscorea 147, 157
——. History of — . . . . . 147—154
——. Cultivation of — 154
——. Bulb-bearing —, Dioscorea bulbifera 159
——. *Chinese*; Dioscorea glabra 161
——. Common 162
——. Common, Dioscorea sativa 164
——. Country or Common, Dioscorea purpurea 163
——. Dark purple 158
——. Kawan, Dioscorea pentaphylla 163
——. Kidney-shaped —, Dioscorea fasciculata 161
——. Fiji —, Dioscorea pentaphylla 163
——. Malacca 158
——. Purple —, Dioscorea purpurea 163
——. Rangoon 158
——. Tivoli; Dioscorea nummularia 162
——. Wing-stalked 157
Yams-kalung, *Tam.*; Dioscorea alata 157
Yamskollung, *Gus.*; Dioscorea sativa 164
Yams. Note on — 166
Yaumúrí nar, Trema amboinensis 319
Yekka, *Tel.*; Calotropis gigantea 186
Yellow-Dye. Note on — 53
————. Exportation to China of — 54
————. Cultivation of trees producing — 54
Yercum, *Tam.*; Calotropis gigantea 186, 327
Yethagyi, *Burm.*; Adhatoda Vasica 67
Yule and Burnell 149, 150

Z

Zamín kand, *Hind.*; Dioscorea bulbifera 159
————, *Pb.*; Dioscorea bulbifera 159
Zea Mays 13, 134, 146
Zizyphus Jujuba 77

Government of India Central Printing Office.—No. 223 R. & A.—31-7-89.—400.

00046017

Digitized with financial assistance from the
Government of Maharashtra
on 18 July, 2018